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MAMMALS OF PANAMA

(WITH THIRTY-NINE PLATES)

BY
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(With 39 Plates)

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1918
LORD BALTIMORE PRESS

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INTRODUCTION

The following report contains an account of all the mammals known to occur in Panama. It is based mainly on the material gathered in the course of the biological survey of the Panama Canal Zone, undertaken in 1910 by the Smithsonian Institution with the approval of the President of the United States and in cooperation with various government departments including the Department of Agriculture and the War Department. The initiation of the survey at this time was due to a realization on the part of naturalists of the importance of making field investigations before the completion of the Panama Canal, when disturbed natural conditions would be likely to complicate problems of geographic distribution in this important region. While the author was assigned to investigate the mammals and birds, and somewhat incidentally the reptiles and amphibians, the personnel of the survey also included field naturalists representing various other branches of natural history. In the preparation of the present report specimens of mammals in various museums have been examined and published records referred to in order to bring together as complete data on the subject as practicable.

The region is of surpassing biological interest, owing to peculiar configuration, varied topography, and geographic position, forming as it does a slender artery blending the complex elements or converging life currents of two continents, and through which countless migrations of non-volant terrestrial animals probably passed during the Tertiary or early Quaternary ages. But of recent migratory movements in the region we have no evidence, and how effective a barrier the completed Panama Canal may prove to be in limiting the distribution of species remains to be determined. The country, said to have been named "Panama" from an Indian word meaning rich in fish, might with equal propriety have received an appellation meaning rich in mammals, or birds.

FIELD INVESTIGATIONS

WORK CONDUCTED BY AUTHOR

In December, 1910, I was detailed by the Chief of the Biological Survey, United States Department of Agriculture, to field work in Panama and arrived in the Canal Zone for that purpose on the 28th day of the month. Proceeding at once to Culebra, the administrative headquarters for the construction of the Panama Canal, I met Colonel (now Major-General) George W. Goethals, the Chairman and Chief Engineer, who expressed the desire of the Isthmian Canal



Fig. 1.—Camp on Cerro Azul. A palm-thatched roof affords shelter from the hardest rain.



Fig. 2.—Field party resting on slope of Cerro Azul. The most practical route is up the bed of a stream.



FIG. 1.—Rio Indio, a small tidal tributary of the Rio Chagres near Gatun, Canal Zone. A favorable collecting ground for mammals and birds.



FIG. 2.—Tidal forest along lower course of Rio Chagres, showing trees with characteristic buttressed bases and aerial roots.

Commission to do everything possible to further the work. A day or two was spent in examining the canal route, and Gatun was chosen as the most favorable point from which to prosecute field work in the Gatun Lake area. Field investigations were begun in that region owing to the obvious importance of making as thorough collections as possible before the biological changes resulting from the transformation of a forest into a lake 164 square miles in area should take place.

For aid in the field I was fortunate in securing Mr. Adan Lizano whose training and experience as taxidermist of the Museo Nacional of Costa Rica rendered him an invaluable assistant. In addition to study and collection of the mammals much time was devoted to the birds, and smaller collections of reptiles and amphibians were made. While the work for the season was concentrated largely in the Gatun Lake area, collections were also made at various localities along the line of the Panama Railroad south to the Pacific coast and at points to the east of the Canal Zone.

On the morning of March 17 we left Panama by launch for Chepo, about 40 miles to the east, en route to the mountains near the headwaters of the Chagres River. Early in the afternoon we entered the broad mouth of the Bayano River and ascended for about 12 miles between lines of low tidal forest to Hato Bayano at the mouth of the Mamoní where we were landed, and the launch continued on up the Bayano to the property of the Bayano Lumber Company. The Bayano is here a large, deep stream with low, but usually rather steep, muddy banks left exposed at low tide. Many alligators, sunning themselves in places where the bank receded, slid slowly into the water as we approached. A dugout canoe was secured and late in the evening our outfit was taken on the high tide to the head of navigation about three miles up the Mamoní River. Leaving our outfit for the night we continued on foot about three miles farther to Chepo, a rambling native village of about 1,000 inhabitants. Chepo is situated on the west bank of the Mamoní River, and near the edge of the most easterly of the open savannas which extend at intervals along the Pacific coast to beyond the Costa Rican frontier. Six or eight miles north of the town a wooded ridge, rising rather steeply from the coastal plain, extends eastward from the main range of the interior, and maintains a general height of about 1,000 feet to the point where it ends rather abruptly in an elbow of the Mamoní. Our objective point was the Cerro Azul, a dominant peak about 3,000 feet high near the continental divide, northwest of Chepo. Two days were spent in outfitting. Small ponies were secured for

use as far as the base of the mountains, and native packers for work on the steep, forested slopes.

On March 20 we left Chepo and traveled about 20 miles, mainly in a westerly course over the "sabanas," crossing the Rio Pacora and turning northward into the forest which forms here a heavy, unbroken cover from the basal slopes of the mountains to their summits and across the Isthmus to the Atlantic coast. The line of demarcation is sharply drawn and we passed almost at a single stride from the broad expanse of brilliantly sunlit savanna into the somber depths of the forest. The pack animals were sent back, and the following day our porters moved the camp equipment about three miles up stream courses, through rough, rocky country to a place called "Cabobré," at 800 feet altitude, on a branch of the Rio Pacora.

A palm-leaf shelter was erected and a comfortable permanent camp established for work on the mountains. Myriads of tiny ticks and innumerable larger ones were, however, found somewhat troublesome at this locality.

Taking two porters, provided with machetes for clearing a trail, and a native hunter, I ascended from camp to the summit of Cerro Azul, March 22. Except in a few places the way was only moderately steep, the most difficult part being at the lower levels where the most practicable route was along stream beds strewn with large, smooth, slippery boulders. Especially when wet these boulders afford a very insecure foothold and several of us were precipitated into the stream, much to the amusement of the remainder of the party. On the upper slopes the forest is of smaller but denser growth, and evidences a much more humid climate above 2,000 feet elevation. The summit, at 3,000 feet, and north slopes for at least 500 feet below, are clothed with a dense growth of low trees, loaded with moss, orchids, and bromeliaceous plants, and similar vegetation is massed in places upon the ground. The Cerro Azul is the highest peak of a range extending north of east from Culebra, increasing in height toward the eastern end west of the Pacora River. Owing to the heavy forest no very clear view could be obtained toward the northwest from the summit, but in that direction a lower range evidently connects with the mountains along the Atlantic coast and separates the Chagres and Pacora watersheds. The northern and eastern slopes are steep and descend to the Pacora, the upper course of which is through rugged country, the river partially encircling the mountain. The air was hazy, but over low, uniformly forested mountains toward the northeast the Caribbean Sea could be seen;



FIG. 1.—Forest along lower course of Rio Chagres, Canal Zone.



FIG. 2.—Forest, extensively invaded by tide, along lower course of Rio Tuyra.



FIG. 1.—Tidal forest, largely mangroves, near Porto Bello.



FIG. 2.—Tidal forest interior near Porto Bello.

also small islands and what appeared to be the western shore of the Gulf of San Blas. The Pacific coast was much more clearly visible, the shore line standing out sharply from near the mouth of the Bayano River as far west as Panama. The dry season was at its height and the coastal plains or "sabanas" resembled a vast, irregular checker-board, the brown areas of grass-land being separated by narrow, parallel belts of green forest marking the courses of streams. The checker-board, or patched appearance, was heightened by numerous lines of fire, advancing over the savannas and leaving blackened areas in their wake.

Exploration, mainly of the upper slopes of Cerro Azul, was continued for several days and on March 27 we returned to Chepo, arriving opportunely to find a launch on which we were able to engage passage to Panama on the following day.

Field work in the Canal Zone was resumed at various points and pushed steadily until May 22, when transportation on a Government tug was secured to Porto Bello. This town is situated on a small bay about 25 miles northeast of Colon. At the Government rock quarry, the source of the supply of much material used in Canal construction, quarters for a large force of men were maintained, and ample facilities afforded for our investigations in the immediate vicinity. Mountains with peaks, including the Cerro Brujo, rise rather steeply to over 3,000 feet, and closely parallel the coast line southward and westward; a lower spur to the north terminating in the rock quarry, encircles the watersheds of the Rio Cascajal, Rio Moré and other short streams converging to the head of the bay. The general shore line is rugged, but mangrove lagoons and swamps occur near the mouth and along the lower course of the Rio Cascajal. The period from June 3 to June 9 was devoted to exploration of the Cascajal River and slopes of Cerro Brujo. Camp equipment was carried by Jamaica negroes who were unaccustomed to such work and proved to be inefficient woodsmen.

The rainy season had begun and the first day out from Porto Bello slow progress was made in traversing swampy country along the lower course of the Cascajal River. Certain boggy areas were crossed by stepping from one small tussock of grass to another. These tussocks, when not too widely spaced, enabled us to pass comfortably over a number of dangerous places, but in spite of great care several members of the party slipped off and, hampered by heavy loads, required prompt assistance in extricating themselves from ooze of unknown depth into which they were rapidly sinking.

Camp for the night was made on the bank of the river where shelter from nearly continuous rain was secured by covering an abandoned native hut with a tent fly. On the following day the swamps were left behind and, as in many other parts of Panama, we found the most practicable route lay along the bed of the stream. Accordingly, we entered the river and waded steadily for eight or ten miles, the water varying from a few inches to waist deep, and care being necessary to avoid the deeper places. The difficulties increased as we advanced toward the interior, as the river banks, at first low, became high and finally merged with the steep general slopes of mountains whose tops were no longer visible, and the bed of the stream assuming a sharper angle became littered in places with huge boulders. The day had been partially clear, but late in the afternoon it began to rain very hard, the river rose several feet in a few minutes and we were obliged to camp at a point on the left bank, indicated by bearings to be about abreast of Cerro Brujo, and which I later decided to use as a base for general work. Poles were cut to form a frame work over which long palm fronds were placed in overlapping position, and a secure shelter from the hardest rain was soon finished. One of our most difficult problems here was to build and maintain a fire. Matches, even when kept well covered, soon absorb sufficient moisture to become unreliable under forest conditions during the rainy season. The natives of the region use flint and steel to generate the spark, which is projected into a small charred roll of cotton cloth kept dry and carefully guarded for the purpose. A smouldering fire in a point of the cloth is used to ignite kindling, and charred remains are always preserved for future use. The only material we found dry enough to burn was the hard heartwood of certain trees, and as we carried only machetes the securing of this firewood entailed considerable labor. Moreover, when gathered, it burned so slowly that the fire barely sufficed for our scanty cooking operations, leaving practically no surplus for drying purposes. I kept one suit of clothing dry for wear in camp, but was obliged each morning to don wet garments for work in the forest.

Wishing to reach as high an elevation as possible on the mountain, the contours of which were difficult to determine, our camp being on the main stream in the bottom of a gorge, a trail was cut through the forest along a narrow ridge between two tributaries whose size indicated distant sources and that the ridge was a spur of the main range. Slopes of varying steepness were encountered and an altitude of about 2,000 feet was reached at a point from which Cerro Brujo,



FIG. 1.—Old line of Panama Railroad, abandoned and nearly submerged by rising waters of Gatun Lake. Looking from Gatun Dam toward Lion Hill, April 30, 1911.



FIG. 2.—Gatun Lake with water rising. New canoe landing near Gatun; old line of Panama Railroad in distance, April 30, 1911.



Fig. 1.—Destruction of forest by rising waters of Gatun Lake.



Fig. 2.—Destruction of forest by rising waters of Gatun Lake.

or a peak in its vicinity, was clearly visible. The outlook from a towering rock showed that our route had been well chosen as it had led steadily upward while jumbled ridges lay to the right and left across deep canyons; but we were separated from the mountain by a rugged depression several hundred feet deep beyond which the main peak rose almost sheer at least 1,000 feet above us. A steep slope to the right appeared practicable for an ascent to the top, but several days had been devoted to working up to this altitude in almost steady rain. With heavy showers frequently recurring and hampering operations, specimens could not be dried and began to mold, and we were forced to retrace our way down the river to Porto Bello where we arrived the evening of June 9, and returned to the Canal Zone, June 14.

Field operations became increasingly difficult owing to the heavy rains and it was decided to discontinue them for the season. I sailed for New York June 24 on the steamer "Colon" and arrived in Washington, June 30.

At the end of the rainy season plans were matured for continuing field work in the Canal Zone under the same auspices, and I left New York for the Isthmus January 9, arriving at Colon on the steamer "Panama" January 15, 1912. Comfortable and convenient quarters at Empire were assigned to me by the Isthmian Canal Commission, and work was at once resumed, largely along the line of the Panama Railroad. My Costa Rican assistant of the previous year, Adan Lizano, was unable to rejoin me and I engaged George G. Scott, who rendered faithful and efficient services throughout the season. Special attention was given to the Gatun Lake area, in the lower parts of which final preparations were being made for raising the water level. Many old houses in process of being demolished afforded unusual opportunities to capture specimens of rare bats. For this same purpose a trip was made about the end of January to caves on the Chilibrillo River, a small tributary entering the Chagres River near Alhajuela at the extreme upper end of the proposed lake basin. The caves were reported to contain remarkable colonies of bats, which would be driven out by the rising water. Water was found flowing through the caves which were formed by large rifts in the limestone formation with numerous lateral chambers resulting from water erosion. One of the larger of the latter was circular, 30 to 40 feet in diameter and about 25 feet from floor to roof. This chamber was totally dark and to the roof large bats of the genus *Phyllostomus* were clinging in dense patches. Several tons of bat

guano on the floor evidenced the occupation of the cave for a long period. Bats of several other species were located in smaller caves and clefts in the vicinity.

Collections of the more easily obtainable species of mammals and birds of the Canal Zone being now fairly complete, a trip to eastern Panama was decided upon in order to determine the relation of the fauna of the Canal Zone to that of South America. In accordance with this plan, arrangements were made through Mr. Pablo Pinel, the Panama agent of the Darien Gold Mining Company, Ltd., to visit the San Miguel Bay region and the company's plant, a favorable location for work in the high mountains near the Colombian frontier. We sailed from Panama on the little steamer "Cana," the evening of February 21. Early on the following morning we were off the mouth of San Miguel Bay. The mangrove-fringed coast was low and no high mountains were at first visible, but the abrupt slopes of Mount Pirre soon began to loom on the southeastern horizon and increased in distinctness as we bore in that direction. The entire day was spent in steaming up the bay and estuary of the Rio Tuyra. Short stops were made at La Palma and Chepigana, native villages, built mainly of palm-thatched houses picturesquely grouped on the southern shore. Along the northern side of the Tuyra, extensive tidal forests included an abundant growth of "cocobola" (*Dalbergia retusa*), the hard wood of which was being cut by a Chinese company for use in the manufacture of knife handles and for other purposes. Anchor was cast in the mouth of the Chucunaque River about dark in the evening, and we were obliged to wait an hour for the tide to rise high enough to enable the little steamer to proceed, arriving about 9.30 p. m. at Marragantí, the station of the Darien Gold Mining Company, near the head of steam navigation, about one and one-half miles above the town of Real de Santa Maria. We were cordially welcomed by the agent, Mr. Pedro Campagnani, to whom I became much indebted for courtesies extended at various times during my stay in the region. On February 23 we continued up the Rio Tuyra about 30 miles by dugout canoe, or "piragua," to Boca de Cupe. Unlike the dugout canoes of the Canal Zone the piragua of this region is truncated and has a platform for the canoeist at each end, admirably adapting it for poling, the native method of progressing either up or down stream. The river banks are low and rather uniformly forested to near the edge of the water, the gigantic "cuipo" trees (*Cavanillesia platanifolia*) presenting striking features and tending to relieve the general monotony. We



FIG. 1.—Rio Tuyra at Boca de Cupe, June 17, 1912.



FIG. 2.—Rio Cascajal near Porto Bello, May 25, 1911.



FIG. 1.—Cuipo tree (*Cavanillesia platanifolia*), a giant of the semi-arid forest ranging from South America north to the Canal Zone.



FIG. 2.—Base of Cuipo tree showing characteristic buttresses and trunk expanded above them.

arrived after nightfall and the piragua was half dragged over shoals by the men who were obliged to jump into the water in places and hold the bow and stern in their hands. The river was very low, owing to the long drought, and the current sets heavily at this season through narrow places which become difficult to navigate in the dark. Boca de Cupe, the last village of importance on the Tuyra, connects with the tramroad to the mines at Cana, in the mountains, 30 miles southward. The first stage of the journey over the tramroad was by a short train drawn by a gasoline motor; this section of the line ending at Mount Kitchener, in the lower foothills of the mountains. Beyond this point the track, winding in tortuous curves up the steep mountain side, was suitable for lighter traffic only, and the 12 miles to Paca were slowly and laboriously traversed by push car, a platform placed on trucks and pushed by men from behind. In descending, the cars, allowed to run by gravity, were rather insecurely controlled by coils of rope wound on the axles. At Paca we were met by a mule-drawn car running to the mines, six miles farther.

The Darien gold mines are located at 2,000 feet altitude near the southeastern base of Mount Pirre, the name applied to the crest of a short range projecting northward from the continental axis formed by the Serrania del Darien. A small plateau, or slightly sloping valley, at about 1,800 feet, extends from near the town across to Mount Setetule, a prominent peak about 4,000 feet high near the center of the amphitheatre formed by the crescentic curve of the mountains bounding the upper Tuyra watershed. Numerous converging streams, principally the Rio Cana, Rio Seteganti, Rio Escucha Ruido and Rio Limon unite in the marshy valley to form the Rio Grande, a local name applied to the upper trunk of the Rio Tuyra. The history of the mines is romantic, dating as it does from the early part of the 16th century when the Spaniards were probably guided to the locality by the Indians. In the 17th century they were reputed to be among the richest gold mines in America, at one time attracting a population of 20,000. They are said to have been reached during this period by a paved road over the mountains from Real de Santa Maria; unbroken forest now covers the route and no one seems to know the exact course followed. Raids by buccaneers and Indian troubles led to their final abandonment by the Spaniards in the 18th century. About 30 years ago they were reopened by an English company, and at irregular intervals have since produced much gold. Various bodies of rich ore are said to have been

exhausted and operating companies became bankrupt before reorganization and further development led to the discovery of new lodes. At the time of our visit a French company was in possession and through the courtesy of the manager, M. Masse, and directors, M. Michel and M. Degoutin, comfortable quarters, transportation and other facilities were provided, without which much of the work accomplished would have been difficult or impossible. The mines were almost ideally located as a base from which to carry on field investigations. Heavily forested mountain slopes cut by numerous streams were of easy access behind the town, while open fields, old clearings and marshy meadows in the valley added to the wealth of environmental combinations.

From February 24 to April 11 work was pushed as rapidly as possible, mainly at various levels from 1,800 to 3,500 feet altitude in the vicinity of the mines.

In early March two days were devoted to a trip to the crest of Mount Pirre to locate a convenient point from which to carry on more extensive exploration of the upper slopes. Although only five or six miles distant from the mines, the top of the range is almost unknown, except to the Choco Indians. An old Indian route along the crest is distinct in places and obliterated in others. Choosing a ridge between the canyons of the Rio Escucha Ruido and the Rio Limon a trail was cut through the forest from the Cana Valley to the summit near the extreme headwaters of the latter stream where my aneroid, set at the known elevation at the mines, and carried up the same day, recorded an altitude of 5,300 feet, and a spring at 5,100 feet was fixed upon as a field base. The dry season affecting the general region was at its height, but above about 4,500 feet we entered a zone shut in by clouds and the forest dripping with moisture contrasted strongly with the arid conditions prevailing a short distance below.

In the latter part of March a week spent at Marragantí enabled me to secure rare material in the tidal area under the favorable conditions afforded by the long drought and resulting low water.

Early in April several thunder storms occurred, but the weather at the gold mines still continued generally dry, and the air became very noticeably hazy, a condition regarded by the people as presaging the coming of the rainy season. Meanwhile the stridulation of cicadas had increased in volume until the notes of many insects often blended in a shrill, vibrant chorus loud enough to interfere appreciably with the detection of other forest sounds.

About this time a swarm of grasshoppers appeared suddenly in some abandoned brush-grown clearings near the gold mines. The insects covered the vegetation over an area 40 or 50 acres in extent so thickly and fed so voraciously that all leaves and tender twigs disappeared in a few hours; and the weight of their bodies broke down many bushes an inch in diameter. They soon disappeared, rising and flying off over the forest, leaving the affected area as sharply outlined as though it had been swept by fire.

On April 12 field equipment was transported by men from the mines to the spring which had previously been chosen on the watershed of the Rio Limon about 200 feet below the crest of Mount Pirre. A small clearing was cut in the forest and a palm-thatched shelter soon erected. We found conditions about as at the time of our brief visit in March, but after April 20 heavy showers became increasingly frequent, indicating the opening of the rainy season. When there was no rain, mist and fog continued to envelop the upper slopes, except for brief intervals during which certain vantage points afforded excellent views of the Serrania del Darien across the Tuyra Valley. The higher mountains visible to the northeast in the vicinity of Mount Tacarcuna appeared to reach about the same height as Mount Pirre. From the Pirre range Vasco Nuñez de Balboa is believed to have discovered the Pacific Ocean in 1513. My outlook in that direction was always obstructed by distant cloud banks or nearer forested ridges converging into the valley of the Rio Tucutí. The cloud effects were sometimes marvellously beautiful, especially in early morning, when distant peaks simulated islands emerging from a frozen sea, or a rift in the floating barrier disclosed the play of a thousand lights and shadows on the dark forest beneath. But such scenes were seldom enjoyed for, although the mountain slopes are steep, they are in few places precipitous, and the dense forest seldom permits an unobstructed view in any direction.

With the progress of the rainy season toads and frogs of widely varying size and form became numerous. As night approached, their peculiar irregularly mingled calls coming from everywhere, in the trees as well as on the ground, began to break the general stillness characteristic of the higher altitudes, and were continued until long after dark. In attempting to secure a specimen that attracted attention in the twilight one evening, it slipped through my fingers, as such amphibians are prone to do, and I was surprised to find that several tadpoles were left in my hand. Other examples of the same species were soon found, bearing six or seven young upon their

backs. A strictly nocturnal note, apparently the stridulation of a cricket or other orthopterous insect was heard only at this locality. The note, cr-r-r-i-i-ick-ít, prolonged tremulously, with a short pause followed by a sharply emphasized terminal syllable was repeated monotonously throughout the night.

Investigation of the various slopes above 4,000 feet was continued until May 6 when we descended to the mines with a valuable collection, which had been dried and maintained in that condition by a camp-fire kept constantly burning. Collections were packed, and I embarked on the first boat for the Canal Zone in order to insure their prompt shipment to Washington and to secure much needed supplies, returning to the Darien region on the same boat, May 17. On May 18, the Tuyra was again ascended by canoe from Marraganti to Boca de Cupe. The river had risen about six feet during the previous night and the strong, dark flood extending from shore to shore contrasted strongly with the clear, shoaly stream up which my men had poled in February. On the following day the journey over the tramroad to Cana was delayed at several points where cuipo trees had fallen across the track. These giants of the forest have comparatively short roots and their hold in the earth is obviously insecure. During storms, especially in the rainy season, numbers of them topple over. The wood is very soft and spongy, and a tree that I chanced to see fall began crumpling in the air and landed in a crushed mass at the bottom of a small canyon.

Field work, temporarily interrupted, was resumed in the vicinity of Cana, May 20. The fauna of the region, especially the birds to which much attention was devoted, seemed inexhaustable. Important additions to collections were made almost daily until June 13, when we returned by the railroad to Boca de Cupe. A week was spent at this point, where the altitude is about 250 feet, and a number of lowland species of mammals and birds were secured. On June 20 we descended the river to Marraganti. A few specimens were obtained the next day and preparations made for embarking on the steamer "Cana" for the Canal Zone, June 22. The steamer sailed at 10 a. m. and made the usual stops at Chepigana and La Palma in passing down the estuary. The aspect of the forest along the shores had changed markedly in appearance, having assumed a brighter green since the advent of the rainy season. Shortly before dark the little steamer began to rock unsteadily in the confused currents of San Miguel Bay, and the receding shore line was suddenly blotted out by a torrential downpour of rain. We reached Panama at



Fig. 1.—Cana, eastern Panama, altitude 2,000 feet, showing adjacent forested slopes. Here are located the Darien Gold Mines.



Fig. 2.—Cana, Panama. Looking east across Cana Valley, Mount Setetule in far distance.



Fig. 1.—Humid Lower Tropical Zone near Cana, eastern Panama, altitude 2,000 feet. Rio Seteganti in foreground; Pirre Range 5,000 feet high in background.



Fig. 2.—Humid Lower Tropical Zone. Forest interior at 300 feet altitude on northern basal slope of Mount Pirre.

11 a. m., June 23, and continued by rail to Empire early in the afternoon. The rainy season being well advanced, preparations were made to return to Washington. On June 27 I sailed from Cristobal on the steamer "Allianca," arriving at New York the afternoon of July 3, and Washington the evening of the same day.

WORK CONDUCTED BY OTHERS

The observations of Lionel Wafer, on which he based his quaint description of the Isthmian fauna in the latter part of the 17th century, furnished for more than 150 years about all that was known of the mammals of the region. While the rich avifauna began to attract attention about the middle of the 19th century, the mammals have, until recently, been neglected; the specimens available for study being limited to a small number taken incidentally by residents, travelers crossing the Isthmus, exploring parties, and collectors who devoted their chief attention to other branches of natural history.

Among the earlier workers was Mr. Thomas Bridges, who arrived at David, Chiriqui, in January, 1856, and remained there until March collecting orchids, also obtaining five species of mammals, as recorded by Sclater (1856, p. 139). Another early visitor to western Panama was the Danish traveler, Andreas Sandøe Örsted, for whom the titi monkey of the region was named by Reinhardt (1872, p. 157).

Enrique Arcé, a native of Guatemala, collected for Messrs. Osbert Salvin and F. Du Cane Godman in Guatemala and Costa Rica, and proceeded about 1865 to Panama, where several years were spent in collecting at various localities in the vicinity of Santiago and in northern Veragua. About 1869 or 1870 he visited David and the Volcan de Chiriqui. His collections were mainly of birds, but a few mammals were sent to the British Museum.

It was not until the year 1900 that mammal collecting by modern methods began in earnest. In March of that year Mr. Wilmot W. Brown, Jr., who was employed by Edward A. and Outram Bangs, began work in Panama that was prosecuted with remarkable success for about a year and a half. Very large bird collections made by him did not preclude the accumulation of extensive series of the mammals. Mr. Brown's first station was Lion Hill, on the Panama Railroad, where, however, few mammals were obtained, the locality being of special ornithological importance. The period from the latter part of April to the middle of May was devoted to a trip to San Miguel, the largest of the Pearl Islands in the Bay of Panama,

where he secured specimens representing practically all of the species of land mammals that occur there, with the possible exception of some bats. Transferring his activities to western Panama he spent nearly a year in intensive work centered in the area between the Pacific coast at David and Pedregal and the summit of the lofty Volcan de Chiriqui. The intermediate localities visited were Divala, Bugaba and Boquete. The results of this work, which also included birds, covering a section with an altitudinal range from sea level to over 11,000 feet, were published by Outram Bangs (1902)[1] and constitute one of the most important contributions to our zoological knowledge of a single area in Middle America. Under the auspices of the John E. Thayer Expedition of 1904, Mr. Brown made a second trip to the Pearl Islands in February, March and April of that year. He visited San Miguel, Saboga and Pacheca islands, but added few mammals to the collection made in 1900. The greater part of May, 1904, was spent by Mr. Brown at Caledonia, near the city of Panama and on the edge of the savanna of the same name, making general collections of vertebrates, especially birds, the locality proving to be poor in mammals.

In 1900 and 1901, while Mr. Wilmot W. Brown, Jr., was engaged in field work in western Panama, a part of the same region was visited by Mr. J. H. Batty. Mammals were collected by him mainly at or near Boqueron and Boquete, but also on Coiba and other islands near the coast. His collection aggregating over 1,000 specimens was divided, a part being acquired by the Hon. Walter Rothschild and a part sold to the American Museum of Natural History. It formed the basis of papers published by Mr. Oldfield Thomas and Dr. J. A. Allen, tending to amplify data in the general field covered by Mr. Outram Bangs. Mr. H. J. Watson, the owner of extensive plantations at Bugaba, Chiriqui, began sending many mammals to the British Museum prior to 1900. Those proving to be new were described at intervals, mainly by Mr. Oldfield Thomas, thus adding further to the comparatively full knowledge of a restricted area in southwestern Panama.

Dr. Thomas Barbour visited the Isthmus early in 1909. From headquarters at Ancon excursions were made between the last of February and the first of April to various points in the Canal Zone, and to some of the islands in the Bay of Panama. His collections were mainly of anatomical and embryological material, including a considerable number of bats from San Pablo. A few bats and other

[1] Accounts of birds were published as follows: Auk, Vol. 18, pp. 355-370, Oct., 1901; Proc. New England Zool. Club, Vol. 3, pp. 15-70, Jan. 30, 1902.

mammals were also collected at various localities by Mr. Henry Pittier, Mr. W. R. Maxon, Dr. S. E. Meek, Mr. S. F. Hildebrand and Mr. August Busck, members of the Smithsonian survey party engaged chiefly in other investigations.

In February, 1912, Mr. Wilfred H. Osgood and assistant passed through the Canal Zone en route to South America, and while waiting about a week for the steamer at Balboa collected mammals, mainly bats. One of the results of his brief work at that point was the re-discovery of *Liomys adspersus* Peters, the exact habitat of which was previously unknown.

During the years 1914 and 1915 several collections were made in Panama for the American Museum of Natural History. In February and March Mr. George Shiras, 3d, well known as a student and photographer of North American mammals, visited the Canal Zone. His work centered in the Gatun Lake area and the results were published the following year. Mr. Shiras was accompanied by Mr. H. E. Anthony, who secured collections of mammals. In October, 1914, the American Museum of Natural History sent Mr. William B. Richardson to eastern Panama, where he collected mammals and birds in the lowlands of the Tuyra Valley until the middle of February, when he met Mr. H. E. Anthony and Mr. D. S. Ball, of the same institution, at Panama. The party outfitted and on February 8 proceeded by launch to Real de Santa Maria. From this point it ascended the Rio Tuyra to the limit of canoe navigation at Tapalisa. Richardson remained at Tapalisa several weeks, while Anthony and Ball continued into the mountains to the old Indian village of Tacarcuna, where collecting was carried on at an elevation of 2,600 feet. Late in March a camp was established for work at 5,200 feet altitude on the upper slopes of Mount Tacarcuna. About the middle of April they were forced by the rainy season to abandon work at the higher elevations. Mr. Anthony and Mr. Ball returned to New York, but Mr. Richardson spent the latter part of April and the month of May collecting at Cituro and Boca de Cupe, in the lowlands of the Tuyra Valley. A general report on the mammals obtained by these expeditions has been published by Anthony (1916).

While the Canal Zone and other limited sections of Panama are now fairly well known, large areas, including important mountain ranges, remain unexplored. One of the least known parts of Panama is the elevated region between the headwaters of the Rio Bayano and the Rio Chucunaque, an area until very recently, at least, controlled by the San Blas Indians, and from which other natives of Panama,

as well as foreigners, were excluded. The region tempted native rubber gatherers inhabiting adjoining territory, who informed me that a spear set in the middle of trails was recognized as a dead line beyond which they passed at their peril. Exploration of mountain ranges between the Canal Zone and the lofty Volcan de Chiriqui would add much to our knowledge of the distribution of many mountain mammals now known only from the extreme eastern or western parts of the republic.

ACKNOWLEDGMENTS

While engaged in field operations in Panama material assistance was received from many persons, some of whom it is impracticable to mention by name, but to all I extend most sincere thanks. Special acknowledgments are due first to Colonel (now Major-General) George W. Goethals, who, as Chairman and Chief Engineer of the Isthmian Canal Commission, furnished transportation, quarters and other facilities, and whose unfailing kindness and courtesy contributed to the pleasure as well as the success of work in the Canal Zone. Other officers to whom special credit should be given are the division engineers, the late Colonel D. D. Gailliard, Colonel (now Major-General) William L. Sibert, and to Chief Quartermaster, Colonel (now Major-General) C. A. Devol; also District Quartermasters Robert M. Gamble, James H. K. Humphrey and Walter G. Ross. Appreciation of the aid of my field assistants, Adan Lizano and George G. Scott, as well as various officials of the Darien Gold Mining Company, has already been expressed in these pages, but I wish to emphasize it again here.

In order to complete the account of the mammals of the region, those of western Panama have been included in the report. For the unrestricted use of material and other favors my thanks are due to the officials of the Museum of Comparative Zoology and American Museum of Natural History, especially Mr. Outram Bangs and Dr. J. A. Allen, under whose direction at the respective institutions the only large collections available from the section named have been brought together. For the loan of certain specimens I am also indebted to Mr. Wilfred H. Osgood of the Field Museum of Natural History. Most of the names of plants used in zone lists have been kindly furnished by Professor Henry Pittier, who had charge of the botanical section of the survey and is the authority on the flowering plants of the region. For a list of characteristic grasses I am under obligations to Professor A. S. Hitchcock. The heads of bats figured were drawn under my direction by Mrs. Ruth Collette Moore.

PHYSIOGRAPHY

The Republic of Panama extends in a sigmoid curve from east to west between the meridians of 77° 15′ and 83° 30′ west from Greenwich and parallels 7° 10′ to 9°-40′ of north latitude. It varies in width from less than 50 miles at the Canal Zone and at the constriction between the mouth of the Rio Chepo and the Bay of San Blas to over 100 miles at the Azuero Peninsula. The most northern points, the small islands and curved coast line about 30 miles northeast of Colon and the disputed territory adjoining Costa Rica northwest of Almirante Bay are in about the same latitude. Except for the Chiriqui Lagoon the northern coast line forms a nearly undented S-shaped curve. The southern coast line, on the contrary, is very irregular. There are numerous inlets or bays, and several peninsulas form prominent salient features. The bays are mainly small, but the Gulf and Bay of Panama together occupy a deep concavity in the eastern section. The smaller bays are mainly the tidal estuaries of the numerous rivers, some of which are of large size. The estuary of the Rio Tuyra permits small steamers to ascend to Real de Santa Maria, about half the distance from the outer shore line across to the Atlantic coast. East of the Gulf of Panama the territory claimed by the republic includes the coast line south to near the mouth of the Rio Juradó in about the same latitude as the southern end of the Azuero Peninsula, which in broadly extended outline bounds the Gulf on the west. Another prominent feature of the southern coast is the narrow Burica Peninsula, a prolongation of the Serrania de Carones near the Panama-Costa Rican boundary. The largest outlying land area is Coiba Island, off the southwestern coast. Immediately south of it is the much smaller island of Jicaron. Numerous small islands lie close to the adjacent coast, of which some of the more important are Cebaco and Leones islands in Montijo Bay, and farther west Insolita, Espartal, Brava, Parida and Sevilla islands. The second largest island is San Miguel, or Rey Island, in the Bay of Panama, which with smaller neighboring islands forms an archipelago known as the Pearl Islands. These islands are rather low, but rugged in contour, with eroding coast lines like those of parts of the adjacent mainland. Taboga Island, a few miles off the Pacific terminus of the Panama Canal, is a health resort utilized during the French as well as American canal construction. Small islands are numerous along the northern coast, but aside from the low, forested archipelago separating the sea from Almirante Bay and the Chiriqui Lagoon, are relatively unimportant.

The general land surface is hilly and irregular, but the only very high mountains are in the extreme western part, where an extension of the highlands of Costa Rica crosses the international boundary about midway between the two oceans and culminates at about 11,500 feet in the volcano of Chiriqui. The higher areas to the east are little known, but the continental divide evidently follows a tortuous course owing to echelon arrangement or other irregularities in the continuity of the principal mountain ranges. It approaches the Pacific side in the vicinity of the Canal Zone and bearing thence diagonally northeastward across the Isthmus continues eastward close to the Atlantic coast, finally curving strongly southward and again approaching the Pacific coast west of the Atrato River Valley.

The rather ill-defined backbone of the Isthmus is divided by comparatively low passes into several irregular sections in which steep, but not usually precipitous, mountain ranges reach varying elevations, in few places exceeding 5,000 feet. One of these, the Serrania de la Capira, lies between the Canal Zone and the slightly elevated region separating the drainage areas of the Rio Coclé del Norte and the Rio Grande de Nata, near the boundary between the provinces of Coclé and Colon. The Serrania del Brujo, beginning near the Atlantic coast a few miles east of Colon, rises near Porto Bello to 3,000 or 4,000 feet, and partially encircling the Chagres River Valley joins the continental axis near Cerro Azul, a mountain about 3,000 feet high on the crest between the Chagres and Pacora river valleys. A short distance east of Cerro Azul are transcontinental gaps probably less than 1,000 feet in altitude where the headwaters of the Rio Mamoní interdigitate with those of streams flowing north into the Gulf of San Blas. Farther east the long, narrow, curved Isthmian backbone, generally known as the Serrania del Darien, reaches in many places an altitude of 3,000 to 5,000 feet, but the crest is interrupted at various points by passes less than 1,000 feet high. Among the lowest gaps known are those near the heads of the Rio Membrillo, the Rio Sucubti and other tributaries of the Rio Chucunaque, whose sources are within a few miles of the Atlantic Ocean. Farther east is Paya Pass where, except at the dryest season, only a few miles separate canoe navigation on the Rio Paya, a Panama tributary of the Rio Tuyra, and the Rio Cacarica, a Colombian affluent of the Rio Atrato. Mount Pirre is the name applied to a dominant spur, slightly exceeding 5,000 feet in altitude and projecting northward into the Tuyra basin in a crescentic curve with the axial trend of the continent along the Panama-Colombian frontier. The Serrania del

Sapo forms a prominent but little-known range extending from Garachine Point at the southern entrance to the Bay of San Miguel, southward along the Pacific coast to a junction with the main range near the international border.

Aside from the higher mountain ranges that form the Isthmian backbone, a multitude of rather steep, extensively eroded ridges separating narrow river valleys ramify throughout the greater part of the republic. Extensive and fairly level plains occur at various elevations, however, in the province of Chiriqui and along the Pacific coast from the Bayano River west to the Canal Zone.

Owing to the narrowness of the Isthmus most of the rivers are short, and from their sources commonly interdigitating along the opposite sides of the deeply eroded continental divide, flow directly to the sea, but there are several notable exceptions. All of the larger rivers of South America, including the Atrato, flow into the Atlantic; it is therefore of interest to note that in eastern Panama the course of the major streams is reversed in conformity with the abruptly altered trend of the continental mass, and a shifting of the crest from the Pacific to the Atlantic side along the Colombian frontier. The greatest river system of the republic is the Tuyra-Chucunaque. After draining a large and very humid area, these two rivers unite near the middle of the Isthmus and in combination with several other large streams pour an immense volume of water into the Gulf of San Miguel. The second river of the republic in point of size is the Rio Bayano, which takes a westerly course and joining the Rio Mamoní, a much smaller stream, turns southward and under the name Rio Chepo enters the Bay of Panama. The most important river of the Atlantic drainage is the Rio Chagres, whose watershed is an interior basin. The general course of the stream is westerly to a point near where it enters the Canal Zone and bends north to the Caribbean Sea. The Chagres, whose waters are now impounded in Gatun Lake, 164 square miles in area, furnishes the water for operating the locks of the Panama Canal, and through the locks at the southern end of Gailliard Cut a part of its flow is diverted into the Pacific Ocean.

While climatic conditions vary considerably in different parts of Panama, the region as a whole is subject to the influence of two annual seasons, the duration of which are correlated with the direction of the prevailing winds. During the so-called "dry" season the northeast trade wind blowing daily from about the month of December to the month of May, at times with considerable violence.

is accompanied by comparatively light, but not infrequent, precipitation along most parts of the Atlantic slope. At this season rather light cloud formations discharge their moisture along the northern side of the Isthmus, the rainfall of the coast depending in a measure on the height and proximity of the mountains. At the higher elevations fogs are very prevalent, and are often so dense that one's vision penetrates only a few feet, and the dimly lighted forest becomes still darker as the cloud mass settles down; a fine spray drifts through the trees and soon the leaves are dripping steadily. The Pacific coast, in marked contrast, has a true dry season, during which little or no rain falls. During the wet season, beginning usually about the latter part of May and ending about the first of December, southerly winds become dominant and rains are more general throughout the Isthmus. At the Canal Zone, which is a cross-section of the Isthmus about 50 miles in extent, the annual rainfall on the Atlantic coast is about double that on the Pacific coast. Official records for 1909 show a total rainfall of 93.06 inches at Balboa, and 183.41 inches at Cristobal; but the average for 13 years at the former station is 71.67, and for 40 years at the latter station 130.03. This relative humidity of the two sides probably obtains as far west as the Costa Rican frontier, but in eastern Panama the difference is less marked. In much of the Darien region the total rainfall is increased to an annual precipitation of perhaps more than 200 inches[1] which renders this area one of the wettest in America.

Excepting at the Canal Zone and limited areas in western Panama the republic is sparsely populated by man; clearings are few, and aside from the rather extensive, open, grassy savannas near the Pacific coast and smaller grass areas in the Chagres Valley, the Isthmus is a practically unbroken expanse of forest. Under the stimulating influence of frequently recurring showers and continuously moist conditions throughout the year, the Atlantic watershed maintains a much more exuberant growth of vegetation than the Pacific watershed, where long periods of drought check vegetative vigor. At the height of the dry season these climatic differences are manifested in the contrasting aspect of the forests on the two slopes. While the trees of the Atlantic forest are clothed with brilliant evergreen foliage, those of the Pacific forest, truly deciduous for the most part, present bare stems, and the landscape has an

[1] During the construction of the Panama Canal 237.28 inches was recorded in a single year, and 58 inches in a single month at Porto Bello, Panama; the annual average, however, was 178.67 during three years of record.

autumnal appearance, relieved to some extent along the borders of streams. It is in this dry forest that one notes the strange habit, possessed by various unrelated species, of producing flowers and ripening fruits while the trees are in a leafless condition.

FAUNAL RELATIONS

The geological structure and history of Panama and Central America in general are, as yet, very imperfectly known. The attenuation of the isthmian region and the slight elevation of various trans-isthmian passes, irrespective of other data, suggest the probable former isolation of the two greater Americas. Some of the passes are less than 500 feet above sea level, and a subsidence of 1,000 feet of the present continental mass would establish interocean connections at various points. Beginning on the south some of these are marked by gaps in the mountains at the source of the Rio Napipi, a tributary of the Rio Atrato, at the Sucubti, an affluent of the Rio Chucunaque, at the Canal Zone, and farther north at Lake Nicaragua and at the Isthmus of Tehauntepec. Such a division would leave a chain of islands, several of the more southern of which would be 3,000 to 4,000 feet high, and it would isolate the high mountains of Costa Rica and Guatemala.

Geological investigations, especially those pursued in connection with Panama Canal construction, indicate that oceanic waters did in fact extend across, at least at the Canal Zone, during the Oligocene period; but the date of land emergence has not been very definitely determined. The slight depth of the water to a submarine escarpment far out along the coasts of Panama, and the present rapid rate of erosion, indicate that the Isthmus was formerly much broader than at present. The encroachment of the sea is well shown along much of the northern coast line, where cliffs receive the full battering effect of the waves swept in by the northerly trade winds. Southerly winds are less dominant, but the southern coast is constantly subjected to the erosive influence of tremendous tides.

Coiba Island and the large islands of the Pearl Archipelago lie in shallow water upon the continental shelf and may have formed parts of an ancient mainland. The excessive rainfall and tendency of isthmian rocks in general to disintegrate rapidly on exposure to the elements also greatly accelerate the reduction of the general land mass.

The Miocene mammalian faunas of southern South America and of North America are known to have been widely different, but a

great gap exists in our knowledge of the contemporaneous fauna of Central America, and northern South America may have been isolated by an Amazonian gulf. Various authorities, however, including Hill,[1] and Scott[2] concur in the belief that North and South America have been united from the Miocene to the present time. Intermigratory movements, probably setting in during the Miocene period, extended through the Pliocene and into the Pleistocene when the interchange of mammalian groups reached its maximum and was followed by extensive extinction, leaving both regions comparatively impoverished. Notably numerous contributions from the North American fauna have, however, persisted and maintain a high state of development in Central and South America.

The mammalian fauna of Panama, as a whole, is South American in the sense that most of the genera and many of the species are common to both regions.

The eastern and western parts of the republic with the Canal Zone as a convenient dividing line, however, present important faunal differences. The former section is more truly South American, especially the mountainous parts, while western Panama partakes of the character of the Central American subregion. The following genera range from South America into eastern Panama, but are not known from the western part of the republic: *Peramys, Rhipidomys, Neacomys, Diplomys, Hydrochœrus, Icticyon, Lonchorina, Macrophyllum, Lonchophylla, Vampyressa, Molossops* and *Leontocebus*. Some of the bats may not improbably prove to be more widely distributed in Central America, but the limits of the other genera in that direction are believed to be approximately fixed. Several rodent genera assignable to the Central American subregion are apparently restricted in the republic to the highlands of the western part, as follows: *Nyctomys, Scotinomys* and *Syntheosciurus*. A few North or Middle American elements, as *Reithrodontomys, Peromyscus, Macrogeomys* and *Cryptotis,* reach the mountains of extreme eastern Panama or cross the Colombian frontier, but are not known from the Canal Zone.

The tendency of the Canal Zone to delimit faunas is indicated by the distribution of various species. The genus *Saimiri* ranges in South America and is apparently absent in eastern and central

[1] Hill, R. T. The Geological History of the Isthmus of Panama and Costa Rica. Bull. Mus. Comp. Zool., Vol. 28, p. 270, June, 1898.

[2] Scott, W. B. The Isthmus of Panama in its Relation to the Animal Life of North and South America. Science, N. S., Vol. 43, No. 1100, p. 117, January 28, 1916.

Panama, but reappears in the western part of the republic where *Saimiri örstedii* is a common species. In *Sciurus hoffmanni* is presented a remarkable case of discontinuous distribution of a species. This common squirrel, living at high and low elevations in Costa Rica and western Panama, appears to be excluded from similar regions throughout eastern Panama, but specimens from Colombia seem indistinguishable from Costa Rican examples. Eastern Panama, it may be noted, is occupied by another common species, *Sciurus gerrardi,* which also has a wide altitudinal range and apparently similar habits. The complementary ranges of these squirrels in the republic, together with the peculiar distribution of *sciurus hoffmanni,* suggests antagonism in ecological relations. Some species, like the two widely dispersed raccoons, *Procyon lotor* and *Procyon cancrivorus,* reach the Canal Zone from opposite directions, but do not pass far beyond it. Several genera have closely allied representatives which are apparently restricted to upper slopes of high mountains of the eastern and western parts of the republic respectively. Examples of such species are *Peromyscus pirrensis* and *Peromyscus flavidus, Oryzomys pirrensis* and *Oryzomys devius.*

LIFE ZONES

Owing to the lack of general knowledge of living forms, as well as of detailed topography of the country and the local distribution of life in Panama, any attempt to delimit life zones at this time must be regarded as provisional. The region as a whole is highly diversified in character, and the number of species of animals and plants to be met with at any given locality is extraordinary. While some generalizations may be based on the field work already accomplished, it is obvious that much more extensive investigations will be necessary before the territory will be adequately known.

Three life zones, or belts, are recognizable in the republic, extending at low elevations from sea to sea, and at higher elevations as belts on the slopes, or embracing the tops of mountain ranges.[1] Beginning at sea level these are the Lower Tropical Zone, of which

[1] The life zones of tropical America, in their general bearings, have been discussed with Dr. Frank M. Chapman, of the American Museum of Natural History, whose special field of study is northwestern South America. Dr. Chapman's work is based on the birds, and it is gratifying to find that, although working independently, we are substantially in accord regarding the number, approximate boundaries, and appropriate nomenclature of the zones. The same general laws clearly apply to the areas studied by Dr. Chapman and myself.

there are well-marked arid and humid divisions; the Upper Tropical, or Subtropical Zone, and the Temperate Zone.

An exhaustive ecological treatment of the animals and plants of the region should recognize aquatic, littoral or riparian, and other associations which, except in a few such instances as those of *Chironectes panamensis, Rheomys raptor, Hydrochœrus isthmius,* and *Trichechus manatus* have comparatively slight significance with reference to mammals alone.

As in the neighboring regions, the life zones are the expression of the influence on organisms of various factors, or varying combinations of factors, of which temperature and moisture, more or less intimately associated, and light, are of prime importance.

The approximate boundaries between zones on different slopes vary in conformity with many of the same modifying conditions as elsewhere; the humidity of a given area is clearly determined by the height of mountains in combination with the direction of prevailing winds.

The zone lists include all of the mammals known from the region, except certain widely ranging species whose distribution have no obvious zone significance. A species or subspecies may occur regularly in two or more life zones, but is usually assignable to one in which it reaches its maximum abundance. Here, as elsewhere, some of the mammals exhibit a tendency to become differentiated in accordance with rather local environmental conditions; thus, a species characterized by dark colors in the humid belt, may be represented by a paler counterpart in more arid territory. The lists of birds are made up mainly of the more characteristic species, and together with the short lists of plants tend to corroborate deductions which might be based on the mammals alone.

LOWER TROPICAL ZONE

The Lower Tropical Zone, an area of high temperature, includes by far the greater part of the Isthmian land surface from the Atlantic and Pacific shore lines across at low elevations from sea to sea and to about 3,000 to 3,500 feet in average altitude along the slopes of the higher mountains. As might be expected, owing to its greater extent, the majority of the animals and plants of the general region are assignable to this zone, and many species, especially of bats, have extended their ranges into all its parts. The zone is, however, divisible into humid and arid divisions, which are denominated the Humid Lower Tropical Zone, and the Arid Lower Tropical Zone,



FIG. 1.—Arid Lower Tropical Zone near southern base of Cerro Azul. Cerro Azul visible in far distance.



FIG. 2.—Humid Lower Tropical Zone at 3,000 feet altitude near summit of Cerro Azul.



FIG. 1.—Humid Lower Tropical Zone. An aquatic environment in the lower Chagres Valley near Bohio, Canal Zone.



FIG. 2.—Humid Lower Tropical Zone. Typical section of forest interior near Gatun, Canal Zone, exposed by clearing of foreground.

respectively. While the total rainfall is more copious in the humid than in the arid division, the most important difference between the two sections is in the comparative continuity of the supply, and its effect on the fauna and flora. Thus, in the humid division moisture in the form of rain or fog is received at very short intervals throughout the year, and when the nights are clear heavy dew exerts its refreshing influence on the vegetation, whereas in the arid division long periods of drought prevail. As a result of these contrasting conditions the leaves are persistent and an evergreen forest, the "rain-forest" of authors, uniformly overspreads the humid division, while in the arid division the leaves are largely deciduous, the forest turns brown during the dry season, and may be interrupted by open, grassy savannas which become parched in appearance. These zonal differences, so well reflected in the character of the flora, are associated with corresponding changes in the fauna.

Mammals of Lower Tropical Zone

[Species marked U. occur also in Upper Tropical Zone].

Chironectes panamensis, Panama Water Opossum.
Didelphis marsupialis etensis, Eten Opossum; Zorro.
Didelphis marsupialis particeps, San Miguel Island Opossum.
Didelphis marsupialis battyi, Batty's Opossum.
Marmosa mexicana isthmica, Isthmian Marmosa.
Marmosa mexicana savannarum, Savanna Marmosa.
Marmosa fulviventer, Fulvous-bellied Marmosa.
Marmosa invicta, Black Marmosa.
Metachirus opossum fuscogriseus, Allen's Opossum; Zorro.
Metachirus nudicaudatus dentaneus, Brown Opossum; Zorro.
Philander laniger derbianus, Derby's Woolly Opossum.
Philander laniger pallidus, Pale Woolly Opossum.
Philander laniger nauticus, Insular Woolly Opossum.
Peramys melanops, Panama Peramys.
Bradypus griseus griseus, Gray Three-toed Sloth.
Bradypus ignavus, Panama Three-toed Sloth.
Cholœpus hoffmanni, Hoffmann's Two-toed Sloth; Perico Lijero.
Cyclopes didactylus dorsalis, Costa Rican Two-toed Anteater.
Tamanduas tetradactyla chiriquensis, Chiriqui Three-toed Anteater.
Myrmecophaga tridactyla centralis, Central American Great Anteater.
Dasypus novemcinctus fenestratus, Costa Rican Four-toed Armadillo.
Cabassous centralis, Central American Five-toed Armadillo.
Trichechus manatus, Manatee.
Pecari angulatus bangsi, Bangs' Collared Peccary; Zahino. U.
Tayassu pecari spiradens, Costa Rican White-lipped Peccary. U.
Odocoileus chiriquensis, Chiriqui White-tailed Deer.
Odocoileus rothschildi, Rothschild's White-tailed Deer.
Mazama sartorii reperticia, Canal Zone Forest Deer.
Tapirella bairdii, Baird's Tapir. U.
Tylomys panamensis, Panama Climbing Rat.
Tylomys watsoni, Watson's Climbing Rat.
Zygodontomys cherriei cherriei, Cherrie's Cane Rat.
Zygodontomys cherriei ventriosus, Canal Zone Cane Rat.
Zygodontomys seorsus, San Miguel Island Cane Rat
Neacomys pictus, Painted Bristly Mouse.
Oryzomys gatunensis, Gatun Rice Rat.
Oryzomys alfaroi dariensis, Darien Rice Rat. U.
Oryzomys bombycinus bombycinus, Silky Rice Rat.
Oryzomys talamancæ, Talamanca Rice Rat.
Oryzomys tectus tectus, Bugaba Rice Rat.
Oryzomys tectus frontalis, Corozal Rice Rat.

Oryzomys fulvescens costaricensis, Costa Rican Pygmy Rice Rat.
Oryzomys caliginosus idoneus, Panama Dusky Rice Rat.
Oryzomys caliginosus chrysomelas, Costa Rican Dusky Rice Rat.
Nectomys alfari efficax, Cana Rice Rat.
Sigmodon hispidus chiriquensis, Boqueron Cotton Rat.
Macrogeomys dariensis, Darien Pocket Gopher. U.
Macrogeomys pansa, Bugaba Pocket Gopher.
Heteromys australis conscius, Cana Pocket Mouse.
Heteromys desmarestianus zonalis, Canal Zone Spiny Pocket Mouse.
Liomys adspersus, Peters' Spiny Pocket Mouse.
Proechimys semispinosus panamensis, Panama Spiny Rat
Proechimys semispinosus burrus, San Miguel Island Spiny Rat.
Diplomys labilis, Gliding Spiny Rat (San Miguel Island).
Diplomys darlingi, Darling's Spiny Rat.
Dasyprocta punctata isthmica, Isthmian Agouti.
Dasyprocta callida, San Miguel Island Agouti.
Dasyprocta coibæ, Coiba Island Agouti.
Cuniculus paca virgatus, Panama Paca.
Hydrochœrus isthmius, Isthmian Capybara.
Coendou rothschildi, Rothschild's Porcupine.
Sciurus variegatoides helveolus, Panama Squirrel.
Sciurus variegatoides melania, Costa Rican Black Squirrel.
Sciurus hoffmanni chiriquensis, Chiriqui Squirrel. U.
Sciurus gerrardi choco, Darien Squirrel.
Sciurus gerrardi morulus, Canal Zone Squirrel.
Microsciurus alfari browni, Brown's Pygmy Squirrel.
Microsciurus alfari venustulus, Canal Zone Pygmy Squirrel.
Microsciurus isthmius vivatus, Mount Pirre Pygmy Squirrel.
Sylvilagus gabbi gabbi, Costa Rican Forest Rabbit.
Sylvilagus gabbi messorius, Panama Forest Rabbit.
Sylvilagus gabbi incitatus, San Miguel Island Rabbit.
Procyon cancrivorus panamensis, Panama Crab-eating Raccoon.
Procyon lotor pumilus, Little Panama Raccoon.
Nasua narica panamensis, Panama Coati. U.
Bassaricyon gabbii gabbii, Costa Rican Bushy-tailed Olingo.
Bassaricyon gabbii orinomus, Panama Bushy-tailed Olingo. U.
Potos flavus isthmicus, Isthmian Kinkajou. U.
Potos flavus chiriquensis, Chiriqui Kinkajou.
Mustela affinis costaricensis, Costa Rican Bridled Weasel. U.
Tayra barbara biologiæ, Panama Tayra.
Grison canaster, Yucatan Grison.
Conepatus tropicalis trichurus, Panama Skunk.
Lutra repanda, Panama Otter.
Felis onca centralis, Central American Jaguar.
Felis pardalis mearnsi, Mearns' Ocelot. U.
Felis pirrensis, Panama Long-tailed Spotted Cat.
Felis bangsi costaricensis, Central American Puma. U.
Herpailurus yagouaroundi panamensis, Panama Gray and Red Cat.
Rhynchiscus naso priscus, Mexican Long-nosed Bat.
Saccopteryx bilineata bilineata, Greater White-lined Bat.
Saccopteryx leptura, Lesser White-lined Bat.
Peropteryx canina canina, Dog-like Bat.
Centronycteris centralis, Thomas' Bat.
Dirias albiventer minor, Little Bull Dog Bat.
Chilonycteris rubiginosa rubiginosa, Dark Brown Bat.
Micronycteris microtis, Nicaraguan Small-eared Bat.
Lonchorina aurita, Tomes' Long-eared Bat.
Tonatia amblyotis, Round-eared Bat.
Macrophyllum macrophyllum, Long-legged Bat.
Phyllostomus hastatus panamensis, Panama Spear-nosed Bat.
Trachops cirrhosus, Fringe-lipped Bat.
Vampyrus spectrum nelsoni, Nelson's False Vampire Bat.
Glossophaga soricina leachii, Leach's Long-tongued Bat.
Lonchophylla robusta, Rusty Long-tongued Bat.
Lonchophylla concava, Panama Long-tongued Bat.
Hemiderma perspicillatum aztecum, Short-tailed Bat.
Hemiderma castaneum, Chestnut Short-tailed Bat.
Uroderma bilobatum, Yellow-eared Bat.
Vampyrops helleri, Heller's Bat.
Vampyrodes major, San Pablo Bat.
Vampyressa minuta, Little Yellow-eared Bat.
Chiroderma isthmicum, Isthmian Bat.
Chiroderma salvini, Salvin's Bat.
Artibeus watsoni, Watson's Bat.
Artibeus jamaicensis jamaicensis, Jamaican Bat.

Artibeus planirostris planirostris, Flat-nosed Bat. U.
Desmodus rotundus murinus, Mexican Vampire Bat.
Natalus stramineus mexicanus, Mexican Straw-colored Bat.
Myotis nigricans, Little Black Bat.
Eptesicus propinquus, Peters' Black Bat.
Dasypterus ega panamensis, Panama Short-eared Bat.
Rhogeëssa tumida, Little Yellow Bat.
Molossops planirostris, Flat-nosed Mastiff Bat.
Eumops nanus, Dwarf Mastiff Bat.
Eumops glaucinus, Chestnut Mastiff Bat.
Molossus coibensis, Coiba Island Mastiff Bat.
Molossus sinaloæ, Sinaloa Mastiff Bat.
Molossus bondæ, Bonda Mastiff Bat.
Saimiri örstedii örstedii, Örsted's Titi Monkey.
Aotus zonalis, Canal Zone Night Monkey.
Leontocebus geoffroyi, Geoffroy's Squirrel Monkey.
Alouatta palliata inconsonans, Panama Howling Monkey. U.
Alouatta coibensis, Coiba Island Howling Monkey.
Cebus capucinus capucinus, Colombian White-throated Capuchin. U.
Cebus capucinus imitator, Panama White-throated Capuchin. U.
Ateles geoffroyi, Geoffroy's Spider Monkey.

Birds of Lower Tropical Zone

Crypturus soui panamensis, Panama Tinamou.
Tinamus castaneiceps, Chestnut-headed Tinamou.
Ibycter americanus, Cacao Hawk.
Herpetotheres cachinnans, Laughing Hawk.
Leucopternis semiplumbea, Dusky-mantled Leucopternis.
Leucopternis ghiesbrechti, Ghiesbrecht's Leucopternis.
Rupornis ruficauda, Rufous-tailed Hawk.
Crax panamensis, Panama Curassow.
Ortalis cinereiceps, Ashy-headed Chachalaca.
Odontophorus melanotis, Black-eared Partridge.
Odontophorus marmoratus, Marbled Partridge.
Odontophorus castigatus, Panama Partridge.
Rhynchortyx cinctus, Banded Partridge.
Eurypyga major, Sun Bittern.
Oreopeleia violacea albiventris, White-bellied Quail Dove.
Oreopeleia chiriquensis, Chiriqui Quail Dove.
Leptotila cassini cassini, Cassin's Dove.
Leptotila rufinucha, Rufous-naped Dove.
Claravis pretiosa, Blue Ground Dove.
Chaemepelia rufipennis rufipennis, Ruddy Ground Dove.
Chaemepelia minuta elæodes, Plain-breasted Ground Dove.
Lepidœnas speciosa, Scaled Pigeon.
Amazona farinosa virenticeps, Green-headed Parrot.
Amazona ochrocephala panamensis, Panama Parrot.
Pionus menstruus, Blue-headed Parrot.
Pyrilia hæmatotis coccinicollaris, Red-necklaced Parrot.
Brotogerys jugularis, Tovi Paroquet.
Eupsittula ocularis, Veragua Paroquet.
Aratinga finschii, Finsch's Paroquet.
Crotophaga ani, Ani.
Crotophaga major, Greater Ani.
Crotophaga sulcirostris, Groove-billed Ani.
Neomorphus salvini, Salvin's Ground Cuckoo.
Coccycua rutila panamensis, Panama Cuckoo.
Veniliornis kirkii neglectus, Divala Woodpecker.
Veniliornis kirkii dariensis, Darien Woodpecker.
Chloronerpes chrysochlorus aurosus, Golden Green Woodpecker.
Chloronerpes callopterus, Panama Green Woodpecker.
Tripsurus pucherani pucherani, Pucheran's Woodpecker.
Tripsurus chrysauchen, Golden-naped Woodpecker.
Centurus subelegans wagleri, Wagler's Woodpecker.
Centurus seductus, San Miguel Woodpecker.
Picumnus olivaceus panamensis, Panama Piculet.
Picumnus olivaceus flavotinctus, Veragua Piculet.
Capito maculicoronatus maculicoronatus, Spotted-crowned Barbet.
Capito maculicoronatus pirrensis, Pirre Barbet.
Selenidera spectabilis, Cassin's Araçari.
Pteroglossus torquatus torquatus, Collared Araçari.
Pteroglossus frantzii, Frantzius' Araçari.
Ramphastos piscivorus brevicarinatus, Short-keeled Toucan.
Galbula melanogenia, Black-chinned Jacamar.
Jacamerops aurea. Great Jacamar.
Chrysotrogon caligatus, Gartered Trogon.
Trogonurus curucui tenellus, Graceful Trogon.

Trogon strigilatus chionurus, White-tailed Trogon.
Trogon bairdii, Baird's Trogon.
Curucujus massena, Massena Trogon.
Curucujus melanurus macrourus, Large-tailed Trogon.
Nonnula frontalis, Panama Nonnula.
Malacoptila panamensis panamensis, Panama Malacoptila.
Ecchaunornis radiatus fulvidus, Fulvous Puff-Bird.
Notharchus tectus subtectus, Panama Pied Puff-Bird.
Hylomanes momotula obscurus, Panama Tody-Motmot.
Urospatha martii semirufa, Greater Rufous Motmot.
Electron platyrhynchum suboles, Darien Motmot.
Electron platyrhynchum minor, Lesser Broad-billed Motmot.
Momotus lessonii lessonii, Lesson's Motmot.
Otus vermiculatus, Vermiculated Screech Owl.
Nyctibius griseus panamensis, Panama Potoo.
Lepidopyga cæruleogularis, Duchassain's Humming Bird.
Polyerata amabilis, Lovely Humming Bird.
Polyerata decora, Charming Humming Bird.
Damophila panamensis, Panama Humming Bird.
Goldmania violiceps, Goldman's Humming Bird.
Chalybura isauræ, Baroness de Lafresnaye's Plumeleteer.
Phæochroa cuvierii cuvierii, Cuvier's Humming Bird.
Phæochroa cuvierii saturatior, Coiba Island Humming Bird.
Threnetes ruckeri, Rucker's Hermit.
Glaucis hirsuta affinis, Lesser Hairy Hermit.
Phæthornis longirostris cephalus, Nicaraguan Hermit.
Eutoxeres aquila salvini, Salvin's Sickle-Bill.
Dendrocincla homochroa ruficeps, Panama Ruddy Dendrocincla.
Dendrocincla lafresnayei ridgwayi, Brown Dendrocincla.
Dendrocincla anabatina saturata, Carriker's Dendrocincla.
Deconychura typica, Cherrie's Deconychura.
Xiphorhynchus lachrymosus lachrymosus, Black-striped Woodhewer.
Xiphorhynchus lachrymosus eximius, Striped-bellied Woodhewer.
Automolus pallidigularis pallidigularis, Pale-throated Automolus.
Automolus pallidigularis exsertus, Chiriqui Automolus.
Hyloctistes virgatus, Striped Hyloctistes.
Xenops genibarbis mexicanus, Mexican Xenops.
Pittasoma michleri michleri, Michler's Ant-pitta.
Phænostictus mcleannani mcleannani, Mc-Leannan's Antthrush.
Hylophylax nævioides, Spotted Antbird.
Formicarius moniliger hoffmanni, Hoffmann's Antthrush.
Formicarius moniliger panamensis, Panama Antthrush.
Myrmeciza læmosticta, Salvin's Antbird.
Myrmeciza zeledoni, Zeledon's Antbird.
Myrmeciza exsul exsul, Sclater's Antbird.
Myrmeciza exsul occidentalis, Cherrie's Antbird.
Gymnocichla nudiceps nudiceps, Bare-crowned Antbird.
Gymnocichla nudiceps erratilis, Costa Rican Bare-crowned Antbird.
Herpsilochmus rufimarginatus exiguus, Rufous-winged Antvireo.
Microbates cinereiventris semitorquatus, Half-collared Antwren.
Myrmopagis fulviventris, Lawrence's Antwren.
Myrmopagis melæna, Black Antwren.
Cymbilaimus lineatus fasciatus, Fasciated Antshrike.
Pachyrhamphus cinnamomeus, Cinnamon Becard.
Sirystes albogriseus, Panama Sirystes.
Microtriccus brunneicapillus, Brown-capped Tyrannulet.
Cotinga ridgwayi, Ridgway's Cotinga.
Cotinga nattererii, Natterer's Cotinga.
Laniocera rufescens, Rufous Manakin.
Manacus vitellinus, Gould's Manakin.
Manacus aurantiacus, Salvin's Manakin.
Myiophobus fasciatus furfurosus, Bran-colored Flycatcher.
Mitrephanes eminulus, Green-backed Fly-catcher.
Cnipodectes subbrunneus, Brown Fly-catcher.
Camptostoma pusillum flaviventre, Yellow-bellied Camptostoma.
Copurus leuconotus, White-backed Copurus.
Tyranniscus vilissimus parvus, Lesser Paltry Flycatcher.
Rhynchocyclus marginatus, Yellow-margined Flycatcher.
Prædo audax, Black-billed Flycatcher.
Craspedoprion æquinoctialis, Equinoctial Flycatcher.
Lophotriccus squamæcristus minor, Zeledon's Helmeted Flycatcher.
Todirostrum nigriceps, Black-headed Tody-Flycatcher.
Oncostoma olivaceum, Lawrence's Bent-billed Flycatcher.
Planesticus grayi casius, Bonaparte's Thrush.



FIG. 1.—Ivory nut palm (*Phytelephas*), Humid Lower Tropical Zone near Porto Bello, showing method of gathering nuts.



FIG. 2.—Ivory nut gatherer's hut, showing product of his industry heaped in foreground.



FIG. 1.—Ferns of Humid Lower Tropical Zone near Cana, eastern Panama, altitude 2,000 feet. *Polypodium aureum* in center.



FIG. 2.—Ferns of Humid Lower Tropical Zone, near Cana, eastern Panama, altitude 2,000 feet. Largely *Dicranopteris bifida.*

Polioptila superciliaris superciliaris, Lawrence's Gnatcatcher.
Leucolepis lawrencii, Lawrence's Musician Wren.
Thryophilus castaneus castaneus, Bay Wren.
Thryophilus galbraithii galbraithii, Galbraith's Wren.
Henicorhina prostheluca pittieri, Pittier's Wood Wren.
Troglodytes musculus inquietus, Panama House Wren.
Pheugopedius fasciatoventris albigularis, Panama Black-bellied Wren.
Pheugopedius fasciatoventris melanogaster, Black-bellied Wren.
Pheugopedius hyperythrus, Tawny-bellied Wren.
Heleodytes albobrunneus, White-headed Cactus Wren.
Pachysylvia aurantiifrons aurantiifrons, Lawrence's Pachysylvia.
Anthus parvus, Panama Pipit.
Basileuterus rufifrons mesochrysus, Sclater's Warbler.
Basileuterus semicervinus veraguensis, Buff-rumped Warbler.
Compsothlypis pitiayumi speciosa, Chiriqui Parula Warbler.
Rhodinocichla rosea eximia, Panama Thrush-Warbler.
Dacnis cayana ultramarina, Ultramarine Dacnis.
Sturnella magna inexspectata, Central American Meadowlark.
Leistes militaris, Cayenne Red-breasted Blackbird.
Icterus mesomelas salvinii, Salvin's Oriole.
Cacicus microrhynchus, Small-billed Cacique.
Cacicus vitellinus, Lawrence's Cacique.
Mitrospingus cassini, Cassin's Tanager.
Chlorothraupis carmioli, Carmiol's Tanager.
Chlorothraupis olivaceus, Yellow-browed Tanager.
Tachyphonus nitidissimus, Veraguan White-shouldered Tanager.
Tachyphonus delatrii, Tawny-crested Tanager.
Tachyphonus luctuosus panamensis, White-shouldered Tanager.
Chrysothlypis chrysomelas chrysomelas, Black and Yellow Tanager.
Tanagra luteicapilla, Yellow-crowned Euphonia.
Tangara florida arcæi, Arce's Emerald Tanager.
Tangara inornata, Plain-colored Tanager.
Saltator atriceps lacertosus, Panama Black-headed Saltator.
Saltator magnoides intermedius, Panama Buff-throated Saltator.
Cyanocompsa concreta cyanescens, Panama Blue Grosbeak.
Arremon aurantiirostris, Orange-billed Sparrow.
Ammodramus savannarum obscurus, Minatitlan Sparrow.
Sporophila minuta minuta, Minute Seed-eater.
Arremonops conirostris conirostris, Lafresnaye's Sparrow.

HUMID LOWER TROPICAL ZONE

The Humid Lower Tropical Zone occupies the crests of most of the mountain ranges, and nearly all that part of the Atlantic watershed of Panama lying below about 3,000 feet altitude. It is replaced, however, in the Chagres Valley by a strip of the Arid Lower Tropical Zone which extends from the Pacific coast across the continental divide in the vicinity of the Panama Canal, but the transition to humid conditions is rapid to the northward of Empire and the bend of the Chagres River. The area is comparatively uniform in character, usually heavily forested, and includes the most luxuriant vegetation on the Isthmus. Trees of large size cast so dense a shade that the undergrowth may be scanty, but wherever much light is admitted the ground cover is very thick, and tangled masses of vines tend to impede progress through the forest. The highest and most massive forest growth, however, is in general at the lower levels. On the upper, or steeper, slopes of the mountains forest cover of a lower growth is apparently the result of unfavorable soil conditions.

Although such slopes are densely wooded, erosion of the entire surface may be rapid, the torrential rains sweeping away humus as fast as deposited.

Mammals of Humid Lower Tropical Zone

Chironectes panamensis, Panama Water Opossum.
Marmosa mexicana isthmica, Isthmian Marmosa.
Marmosa invicta, Black Marmosa.
Metachirus nudicaudatus dentaneus, Brown Opossum; Zorro.
Philander laniger derbianus, Derby's Opossum.
Peramys melanops, Panama Peramys.
Mazama sartorii reperticea, Canal Zone Forest Deer.
Tapirella bairdii, Baird's Tapir.
Zygodontomys cherriei ventriosus, Canal Zone Cane Rat.
Neacomys pictus, Painted Bristly Mouse.
Oryzomys gatunensis, Gatun Rice Rat.
Oryzomys alfaroi dariensis, Darien Rice Rat.
Oryzomys bombycinus bombycinus, Silky Rice Rat.
Oryzomys talamancæ, Talamanca Rice Rat.
Oryzomys tectus frontalis, Corozal Rice Rat.
Oryzomys caliginosus idoneus, Panama Dusky Rice Rat.
Nectomys alfari efficax, Cana Rice Rat.
Heteromys australis conscius, Cana Pocket Mouse.
Heteromys desmarestianus zonalis, Canal Zone Spiny Pocket Mouse.
Dasyprocta punctata isthmica, Isthmian Agouti.
Microsciurus alfari venustulus, Canal Zone Pygmy Squirrel.
Bassaricyon gabbii gabbii, Costa Rican Bushy-tailed Olingo.
Lutra repanda, Panama Otter.

Birds of Humid Lower Tropical Zone

Leucopternis ghiesbrechti, Ghiesbrecht's Leucopternis.
Crax panamensis, Panama Curassow.
Odontophorus marmoratus, Marbled Partridge.
Eurypyga major, Sun Bittern.
Oreopeleia violacea albiventris, White-bellied Quail Dove.
Leptotila cassini cassini, Cassin's Dove.
Neomorphus salvini, Salvin's Ground Cuckoo.
Coccycua rutila panamensis, Panama Cuckoo.
Chloronerpes callopterus, Panama Green Woodpecker.
Tripsurus pucherani pucherani, Pucheran's Woodpecker.
Picumnus olivaceus panamensis, Panama Piculet.
Capito maculicoronatus maculicoronatus, Spotted-crowned Barbet.
Capito maculicoronatus pirrensis, Pirre Barbet.
Jacamerops aurea, Great Jacamar.
Selenidera spectabilis, Cassin's Araçari.
Ramphastos piscivorus brevicarinatus, Short-keeled Toucan.
Curucujus melanurus macrourus, Large-tailed Trogon.
Nonnula frontalis, Panama Nonnula.
Ecchaunornis radiatus fulvidus, Fulvous Puff-Bird.
Notharchus tectus subtectus, Panama Pied Puff-Bird.
Hylomanes momotula obscurus, Panama Tody-Motmot.
Electron platyrhynchum minor, Lesser Broad-billed Motmot.
Electron platyrhynchum suboles, Darien Motmot.
Urospatha martii semirufa, Greater Rufous Motmot.
Polyerata amabilis, Lovely Hummingbird.
Domophila panamensis, Panama Hummingbird.
Goldmania violiceps, Goldman's Hummingbird.
Chalybura isauræ, Baroness de Lafresnaye's Plumeleteer.
Threnetes ruckeri, Rucker's Hermit.
Glaucis hirsuta affinis, Lesser Hairy Hermit.
Eutoxeres aquila salvini, Salvin's Sicklebill.
Dendrocincla lafresnayei ridgwayi, Brown Dendrocincla.
Xiphorhynchus lachrymosus lachrymosus, Black-striped Woodhewer.
Automolus pallidigularis pallidigularis, Pale-throated Automolus.
Hyloctistes virgatus, Striped Hyloctistes.
Pittasoma michleri michleri, Michler's Ant-pitta.
Phænostictus mcleannani mcleannani, McLeannan's Antthrush.
Hylophylax nævioides, Spotted Antbird.
Formicarius moniliger panamensis, Panama Antthrush.
Myrmeciza læmosticta, Salvin's Antbird.
Myrmeciza zeledoni, Zeledon's Antbird.
Myrmeciza exsul exsul, Sclater's Antbird.

Gymnocichla nudiceps nudiceps, Bare-crowned Antbird.
Microbates cinereiventris sumitorquatus, Half-collared Antwren.
Myrmopagis fulviventris, Lawrence's Antwren.
Myrmopagis melæna, Black Antwren.
Cymbilaimus lineatus fasciatus, Fasciated Antshrike.
Herpsilochmus rufimarginatus exiguus, Rufous-winged Antvireo.
Pachyrhamphus cinnamomeus, Cinnamon Becard.
Sirystes albogriseus, Panama Sirystes.
Microtriccus brunneicapillus, Brown-capped Tyrannulet.
Cotinga nattererii, Natterer's Cotinga.
Laniocera rufescens, Rufous Manakin.
Manacus vitellinus, Gould's Manakin.
Mitrephanes eminulus, Green-backed Flycatcher.
Cnipodectes subbrunneus, Brown Flycatcher.
Rhynchocyclus marginatus, Yellow-margined Flycatcher.
Prædo audax, Black-billed Flycatcher.
Craspedoprion æquinoctialis, Equinoctial Flycatcher.
Lophotriccus squamæcristus minor, Zeledon's Helmeted Flycatcher.
Todirostrum nigriceps, Black-headed Tody-Flycatcher.
Leucolepis lawrencii, Lawrence's Musician Wren.
Thryophilus castaneus castaneus, Bay Wren.
Thryophilus galbraithii galbraithii, Galbraith's Wren.
Pheugopedius fasciato ventris albigularis, Panama Black-bellied Wren.
Pachysylvia aurantiifrons aurantiifrons, Lawrence's Pachysylvia.
Compsothlypis pitiayumi speciosa, Chiriqui Parula Warbler.
Dacnis cayana ultramarina, Ultramarine Dacnis.
Icterus mesomelas salvinii, Salvin's Oriole.
Tachyphonus delatrii, Tawny-crested Tanager.
Chlorothraupis carmioli, Carmiol's Tanager.
Chlorothraupis olivaceus, Yellow-browed Tanager.
Tachyphonus luctuosus panamensis, White-shouldered Tanager.
Chrysothlypis chrysomelas chrysomelas, Black and Yellow Tanager.
Tangara florida arcæi, Arce's Emerald Tanager.
Tangara inornata, Plain-colored Tanager.
Saltator atriceps lacertosus, Panama Black-headed Saltator.
Cyanocompsa concreta cyanescens, Panama Blue Grosbeak.
Arremonops conirostris conirostris, Lafresnaye's Sparrow.

Plants of Humid Lower Tropical Zone

Lycopodium dichotomum.
Polypodium aureum.
Dicranopteris bifida.
Anthurium acutangulum.
Anthurium hacumense.
Anthurium maximum.
Montrichardia arborescens.
Philodendron brevispathum.
Xanthosoma helleborifolium.
Aechmea dactylina.
Aechmea tillandsioides.
Guzmania angustifolia.
Guzmania zahnii.
Pitcairnia atrorubens.
Heliconia wagneriana.
Piper aduncum.
Piper cordulatum.
Brosimum utile.
Piratinera panamensis.
Cecropia arachnoides, Guarumo.
Cecropia longipes, Guarumo.
Cecropia mexicana, Guarumo.
Ficus panamensis, Panama Wild Fig.
Ficus hemsleyana, Hemsley's Wild Fig.
Ficus pittieri, Pittier's Wild Fig.
Inophleum·armatum, Maragua; Cocuá.
Orycthanthus ligustrinus.
Guatteria amplifolia.
Virola panamensis.
Acacia hayesii, Hayes' Acacia.
Acacia melanoceras.
Acacia multiglandulosa.
Inga goldmaniana.
Inga portobellensis.
Pithecolobium cognatum.
Pithecolobium fragans.
Pithecolobium latifolium.
Prioria copaifera.
Swartzia grandiflora.
Swartzia panamensis, Cutaro.
Erythrina costaricensis, Costa Rican Erythrina.
Meibomia adscendens.
Coumarouna panamensis.
Acalypha diversifolia leptostachya.
Croton billbergianus.
Euphorbia ammannioides.
Sapium giganteum.
Cupania fulvida.
Sloanea megalophylla.
Heliocarpus appendiculatus.
Hibiscus bifurcatus.
Hibiscus spathulatus.
Lopimia dasypetala.
Pavonia racemosa.
Peltæa ovata.

Sida rhombifolia.
Pachira aquatica.
Quararibea pterocalyx.
Eschweilera panamensis.
Eschweilera reversa.
Gustavia nana.
Gustavia parvifolia.
Combretum coccineum.
Combretum epiphyticum.
Combretum punctulatum.
Aciotis purpurascens.
Clidemia dentata.
Clidemia petiolaris.
Conostegia speciosa.
Conostegia subcrustulata.
Leandra cinnamomea.
Leandra mexicana.
Miconia barbinervis.
Miconia nervosa.
Oxymeris cinnamomea.
Oxymeris heterobasis.
Sagræa petiolata.
Styrax argenteum.
Mimusops dariensis?
Malouetia panamensis.
Enallagma cucurbitina.
Jacaranda copaia.
Macfadyena uncinata.
Aphelandra sinclairiana.
Aphelandra tetragona.
Diodia radula.
Cassupa panamensis.
Macrocnemum glabrescens.
Morinda panamensis.
Psychotria magna.
Rustia ferruginea.
Rustia occidentalis.
Watsonamra gymnopoda.
Watsonamra macrophylla.
Watsonamra magnifica.
Watsonamra pittieri.
Watsonamra pubescens.

ARID LOWER TROPICAL ZONE

The Arid Lower Tropical Zone extends in a belt of varying width, mainly at low elevations, all along the southern side of the Isthmus, excepting possibly the extreme southeastern part, from the Pacific coast line to near the base of the higher mountains, reaching farthest inland along the valley of the Tuyra River and at the base of the Azuero Peninsula. In the vicinity of the Canal Zone it crosses the continental divide and invades a part of the valley of the Chagres River; important islands off the coast are also included in its scope.

The total rainfall is by no means scanty, and in the wet season the forested parts of this zone differ little in appearance from Humid Lower Tropical areas, truly arid conditions prevailing only during the dry season when much of the forest, except near water, is leafless and the contrast with the continuously humid areas is very striking. A number of trees exhibit the strange habit of devoting the wet season to purely vegetative functions; under the stimulation of the first rains newly formed leaves and rapidly lengthening branches give the forest a spring-like appearance, but the flowering and maturing of fruit is deferred until the dry season, when the leaves have fallen and general growth has stopped.

Mammals of Arid Lower Tropical Zone

Didelphis marsupialis particeps, San Miguel Island Opossum (San Miguel Island).
Didelphis marsupialis battyi, Batty's Opossum (Coiba Island).
Marmosa mexicana savannarum, Savanna Marmosa.
Marmosa fulviventer, Fulvous-bellied Marmosa (San Miguel Island).
Philander laniger pallidus, Pale Woolly Opossum.
Philander laniger nauticus, Insular Woolly Opossum.
Odocoileus chiriquensis, Chiriqui White-tailed Deer.
Odocoileus rothschildi, Rothschild's White-tailed Deer (Coiba Island).

Zygodontomys cherriei cherriei, Cherrie's Cane Rat.
Zygodontomys seorsus, San Miguel Island Cane Rat (San Miguel Island).
Oryzomys tectus tectus, Bugaba Rice Rat.
Oryzomys fulvescens costaricensis, Costa Rican Pygmy Rice Rat.
Oryzomys caliginosus chrysomelas, Costa Rican Dusky Rice Rat.
Macrogeomys pansa, Bugaba Pocket Gopher.
Liomys adspersus, Peters' Spiny Pocket Mouse.
Proechimys semispinosus burrus, San Miguel Island Spiny Rat (San Miguel Island).
Diplomys labilis, Gliding Spiny Rat (San Miguel Island).
Dasyprocta callida, San Miguel Island Agouti (San Miguel Island).
Dasyprocta coibae, Coiba Island Agouti (Coiba Island).
Sciurus variegatoides helveolus, Canal Zone Squirrel.
Sciurus variegatoides melania, Costa Rican Black Squirrel.
Microsciurus alfari browni, Brown's Pygmy Squirrel.
Sylvilagus gabbi incitatus, San Miguel Island Rabbit (San Miguel Island).
Alouatta coibensis, Coiba Island Howling Monkey (Coiba Island).

Birds of Arid Lower Tropical Zone

Rupornis ruficauda, Rufous-tailed Hawk.
Odontophorus castigatus, Panama Partridge.
Leptotila rufinucha, Rufous-naped Dove.
Eupsittula ocularis, Veragua Paroquet.
Crotophaga sulcirostris, Groove-billed Ani.
Centurus seductus, San Miguel Woodpecker (San Miguel Island).
Veniliornis kirkii neglectus, Divala Woodpecker.
Veniliornis kirkii dariensis, Darien Woodpecker.
Tripsurus chrysauchen, Golden-naped Woodpecker.
Picumnus olivaceus flavotinctus, Veragua Piculet.
Pteroglossus frantzii, Frantzius' Araçari.
Trogon bairdii, Baird's Trogon.
Polyerata decora, Charming Hummingbird.
Phæochroa cuvierii cuvierii, Cuvier's Hummingbird.
Phæochroa cuvierii saturatior, Coiba Hummingbird (Coiba Island).
Dendrocincla homochroa ruficeps, Panama Ruddy Dendrocincla.
Dendrocincla anabatina saturata, Carriker's Dendrocincla.
Deconychura typica, Cherrie's Deconychura.
Xiphorhynchus lachrymosus eximius, Striped-bellied Woodhewer.
Automolus pallidiventris exsertus, Chiriqui Automolus.
Formicarius moniliger hoffmanni, Hoffmann's Antthrush.
Gymnocichla nudiceps erratilis, Costa Rican Bare-crowned Antbird.
Myrmeciza exsul occidentalis, Cherrie's Antbird.
Cotinga ridgwayi, Ridgway's Cotinga.
Carpodectes antoniæ, Antonia's Cotinga.
Manacus aurantiacus, Salvin's Manakin.
Myiophobus fasciatus furfurosus, Bran-colored Flycatcher.
Camptostoma pusillum flaviventre, Yellow-bellied Camptostoma.
Pheugopedius hyperythrus, Tawny-bellied Wren.
Pheugopedius fasciatoventris melanogaster, Black-bellied Wren.
Anthus parvus, Panama Pipit.
Basileuterus semicervinus veraguensis, Buff-rumped Warbler.
Sturnella magna inexspectata, Central American Meadowlark.
Leistes militaris, Cayenne Red-breasted Blackbird.
Lanio melanopygius, Black-rumped Shrike-Tanager.
Ammodramus savannarum obscurus, Minatitlan Sparrow.
Sporophila minuta minuta, Minute Seed-eater.

Plants of Arid Lower Tropical Zone

(Excepting those of Savanna Area and Semi-forested Savanna borders)

Anthurium gracile.
Aechmea setigera.
Piper grandifolium.
Piper hispidum.
Ficus glaucescens, Glaucous Wild Fig.
Ficus isophlebia.
Ficus oerstediana, Örsted's Wild Fig.
Ficus williamsii, Williams' Wild Fig.
Loranthus avicularius.
Loranthus polyrhizos.
Loranthus theobromæ.
Orycthanthus occidentalis.
Struthanthus orbicularis.
Annona hayesii, Hayes' Annona.
Annona frutescens.
Hirtella americana.
Licania arborea.
Licania hypoleuca.
Licania platypus.
Acacia penonomensis, Penonomé Acacia.

Calliandra emarginata.
Calliandra pittieri, Pittier's Calliandra.
Enterolobium schomburgkii.
Enterolobium cyclocarpum.
Inga cocleensis.
Inga hayesii.
Inga laurina.
Inga mucuna.
Inga paciflora.
Inga pittieri.
Mimosa panamensis, Panama Mimosa.
Mimosa somnians.
Mimosa williamsii, William's Mimosa.
Pithecolobium oblongum.
Bauhinia hymenæfolia.
Bauhinia inermis.
Bauhinia pauletia.
Browneopsis excelsa, Cuchillito.
Cassia foliolosa.
Cassia pauciflora.
Chamæcrista brevipes.
Chamæcrista flexuosa.
Chamæcrista tristicula.
Hymenæa courbaril.
Andira inermis.
Centrolobium patinense, Amarillo de Guayaquil.
Centrolobium yavizanum.
Erythrina rubrinervia.
Lennea viridiflora.
Lonchocarpus velutinus.
Macherium purpurascens.
Meibomia spiralis.
Platymiscium polystachyum.
Lesbania macrocarpa.
Sweetia panamensis.
Peltogyne purpurea.
Dimorphandra megistosperma, Alcornoque.
Dalbergia retusa, Cocobola.
Platypodium maxonianum.
Cedrela fissilis.
Cedrela mexicana, Spanish Cedar.
Guarea williamsii.
Swietenia macrocarpa, Mahogany.
Vochysia ferruginea.
Caperia panamensis.
Euphorbia apocynoides.
Hieronymia alchorneoides.
Anacardium rhinocarpus, Espavé.
Cupania guatemalensis.
Serjania grandis.
Serjania seemanni.
Talisia panamensis.
Goethalsia isthmica.
Heliocarpus arborescens.
Abutilon graveolens.
Hibiscus costatus.
Malache panamensis.
Malvaviscus mollis.
Bambacopsis sessilis.
Ceiba pentandra.
Cavanillesia platanifolia, Cuipo.
Melochia hirsuta.
Eschweilera garagaræ.
Eschweilera verruculosa.
Gustavia microcarpa.
Combretum alternifolium.
Combretum jacquini.
Combretum lepidopetalum.
Clidemia dependens.
Clidemia spicata.
Miconia gracilis.
Sagræa rubra.
Achras sapota.
Styrax argenteum.
Mimusops panamense.
Cordia riparia.
Cordia ulmifolia.
Vitex masoniana.
Amphilophium panniculatum.
Anemopægma orbiculatum.
Arrabidæa pachycalyx.
Jacaranda felicifolia.
Aphelandra pectinata.
Barleria micans.
Elytraria squamosa.
Palicourea parviflora.
Rondeletia panamensis.
Watsonamra brachyotis.
Watsonamra tinajita.

SAVANNA AREA AND SEMI-FORESTED SAVANNA BORDERS

Two principal upland associational divisions, with important bearing on mammalian life, are recognizable in the Arid Lower Tropical Zone. These are an arid or semi-arid forest association, and a savanna and savanna border association. The forests are generally continuous along the basal slopes of the mountains and cover irregular contours to near the sea. They also extend as semi-arid belts along the river valleys. Small patches of forest in savanna regions may be the result of softer soil or other local conditions. Open, grassy plains or savannas, often of wide extent, cover generally level areas along the Pacific slope from near the Costa Rican frontier



FIG. 1.—Savanna near southern base of Cerro Azul, southern Panama.



FIG. 2.—Savanna near Corozal, Canal Zone.



FIG. 1.—Upper Tropical Zone at 3,500 feet altitude on Mount Pirre. Looking over forest and clouds in Cana Valley.



FIG. 2.—Upper Tropical Zone near summit of Mount Pirre, altitude 5,000 feet. Palms and ferns are more abundant here than at lower elevations.

eastward to the Bayano River. Savannas also occur in the valley of the Chagres River, east of the Canal Zone. Some mammals and birds are not very definitely assignable to either area, as they find their most congenial habitat along the forest borders where they seek food in the open spaces and retire to the woodland for shelter. The savannas are now devoted largely to stock raising and during the dry season large parts of their surface are swept by fire which destroys much of the smaller animal life. Some of the hawks are said to have learned to patrol the fire lines, ready to pounce upon small rodents and other creatures attempting to escape. While viewing the smoking plains from a vantage point on Cerro Azul, one of my native packers told me that a large hawk is locally known as "bebe-humo" (literally, "drink smoke") from its habit of flying close to the fire.

Mammals of Savanna Area and Semi-forested Savanna Borders

Marmosa mexicana savannarum, Savanna Marmosa.
Philander laniger pallidus, Pale Woolly Opossum.
Odocoileus chiriquensis, Chiriqui White-tailed Deer.
Zygodontomys cherriei cherriei, Cherrie's Cane Rat.
Oryzomys tectus tectus, Bugaba Rice Rat.
Oryzomys fulvescens costaricensis, Costa Rican Pygmy Rice Rat.
Oryzomys caliginosus chrysomelas, Costa Rican Dusky Rice Rat.
Macrogeomys pansa, Bugaba Pocket Gopher.
Liomys adspersus, Peters' Spiny Pocket Mouse.
Sciurus variegatoides helveolus, Canal Zone Squirrel.
Sciurus variegatoides melania, Costa Rican Black Squirrel.
Sylvilagus gabbi consobrinus, Savanna Rabbit.

Birds of Savanna Area and Semi-forested Savanna Borders

Rupornis ruficauda, Rufous-tailed Hawk.
Crotophaga sulcirostris, Groove-billed Ani.
Pheugopedius hyperythrus, Tawny-bellied Wren.
Anthus parvus, Panama Pipit.
Sturnella magna inexspectata, Central American Meadow Lark.
Leistes militaris, Cayenne Red-breasted Blackbird.
Ammodramus savannarum obscurus, Minatitlan Sparrow.
Sporophila minuta minuta, Minute Seed-eater.

Plants of Savanna Area and Semi-forested Savanna Borders

Andropogon bicornis.
Andropogon condensatus.
Andropogon fastigiatus.
Andropogon hirtiflorus.
Andropogon leucostachyus.
Andropogon tener.
Axonopus compressus.
Axonopus marginatus.
Cymbopogon bracteatus.
Elionurus tripsacoides.
Paspalum gardnerianum.
Paspalum heterotrichon.
Paspalum minus.
Paspalum notatum.
Paspalum pilosum.
Paspalum plicatulum.
Paspalum stellatum.
Sporobolus indicus.
Thrasya campylostachya.
Trachypogon montufari.
Bromelia pinguin.
Roupala complicata.
Xylopia grandiflora.
Chamæcrista tagera.
Diphysa carthagenensis.
Indigofera pascuorum.
Indigofera suffruticosa.
Meibomia angustifolia.
Phaseolus gracilis.
Byrsonima cumingiana, Nancé.

Sloanea quadrivalvis.
Peltæa sessiliflora.
Sida jamaicensis.
Sida linifolia.
Guazuma ulmifolia, Guacimo.
Curatella americana.
Miconia rubiginosa.
Miconia fulva.
Lantana camara.
Cornutia pyramidata.
Duranta plumieri.
Diodia rigida.
Pectis elongata.
Pectis swartziana.

UPPER TROPICAL ZONE

With the exception of the lofty Volcan de Chiriqui, the Upper Tropical Zone embraces the slopes and crests of mountains above 3,000 to 8,500 feet altitude. Its upward extent on the Volcan de Chiriqui has not been accurately determined, but probably reaches on general slopes to near the 8,000-foot contour line or somewhat higher. Practically the entire area is densely forested, but the forest, largely of palms, is of somewhat smaller growth than in much of the Lower Tropical Zone. While the zone as a whole is humid, no very definite divisions on the basis of moisture being now recognizable in Panama, variations in humidity due to slope exposure are often marked. The northeast trade winds cause precipitation or cloud formation, affecting the northern slopes of the mountains in this zone during the so-called " dry " season. Fogs and generally moist conditions extending across the summits reach about 500 feet down the southern slope, below which their influence rapidly diminishes, the altitude of the line of demarcation depending on that of the crest. An extract from the itinerary of Mr. W. W. Brown, Jr., quoted by Mr. Outram Bangs[1] is descriptive of this zone on the Volcan de Chiriqui. It runs as follows:

On the further side of the llano, at an altitude of 3,500 feet, the trail leaves the plain and passes through valleys and over hills, in a cool luxuriant forest with swiftly running streams and brooks rippling among fern-covered rocks. One begins to see an immense number of birds, all of different species from those of the lowlands—water ouzels dart about on the rocks in the foaming, rushing streams, small thrushes (*Catharus*) and solitaires are singing everywhere in the jungle and the branches overhead are full of tanagers and warblers. This Zone extends up to about 5,000 feet. Between 5,000 and 8,000 feet another change in the bird life is noticed, but not so marked a one.

More complete knowledge of the 4,500 to 5,000 feet of altitudinal extent assigned to this zone may point to the desirability of making divisions which are not satisfactorily recognizable now.

[1] The Auk, Vol. 3, p. 17, Jan. 30, 1902.

Mammals of Upper Tropical Zone

[Species marked L. occur also in Lower Tropical Zone.]

Pecari angulatus crusnigrum, Chiriqui Collared Peccary. L.
Reithrodontomys mexicanus cherrii, Cherrie's Harvest Mouse.
Peromyscus flavidus, Volcan Mouse.
Peromyscus pirrensis, Mount Pirre Mouse.
Peromyscus nudipes, La Carpintera Mouse.
Nyctomys sumichrasti nitellinus, Chiriqui Vesper Rat.
Rhipidomys scandens, Mount Pirre Climbing Mouse.
Tylomys fulviventer, Fulvous-bellied Climbing Rat.
Scotinomys teguina apricus, Boquete Brown Mouse.
Oryzomys alfaroi alfaroi, Alfaro's Rice Rat. L.
Oryzomys devius, Boquete Rice Rat.
Oryzomys pirrensis, Mount Pirre Rice Rat.
Oryzomys fulvescens vegetus, Volcan Chiriqui Pygmy Rice Rat.
Rheomys raptor, Panama Water Mouse.
Macrogeomys cavator, Chiriqui Pocket Gopher.
Heteromys desmarestianus repens, Chiriqui Spiny Pocket Mouse.
Heteromys desmarestianus panamensis, Panama Spiny Pocket Mouse.
Heteromys desmarestianus crassirostris, Mount Pirre Spiny Pocket Mouse.
Dasyprocta punctata dariensis, Darien Agouti.
Coendou mexicanum lænatum, Chiriqui Porcupine.
Sciurus hoffmanni chiriquensis, Chiriqui Squirrel. L.
Sciurus gerrardi choco, Darien Squirrel. L.
Microsciurus boquetensis, Chiriqui Pygmy Squirrel.
Syntheosciurus brochus, Groove-toothed Squirrel.
Icticyon panamensis, Panama Bush Dog.
Bassariscus sumichrasti notinus, Panama Bassariscus.
Nasua narica panamensis, Panama Coati. L.
Bassaricyon gabbii orinomus, Panama Bushy-tailed Olingo. L.
Potos flavus isthmicus, Isthmian Kinkajou. L.
Mustela frenata costaricensis, Costa Rican Bridled Weasel. L.
Conepatus tropicalis trichurus, Panama Skunk. L.
Felis pardalis mearnsi, Mearns' Ocelot.
Felis bangsi costaricensis, Central American Puma.
Cryptotis merus, Mount Pirre Shrew.
Diclidurus virgo, Costa Rican White Bat (Probably also Lower Tropical).
Sturnira lilium parvidens, Northern Yellow-shouldered Bat (Probably also Lower Tropical).
Diphylla centralis, Central American Vampire Bat (Probably also Lower Tropical).
Eptesicus fuscus miradorensis, Mirador Brown Bat.
Nycteris borealis mexicana, Mexican Red Bat.
Alouatta palliata inconsonans, Panama Howling Monkey. L.
Cebus capucinus capucinus, Colombian White-throated Capuchin. L.
Cebus capucinus imitator, Panama White-throated Capuchin. L.
Ateles dariensis, Darien Black Spider Monkey. L.

Birds of Upper Tropical Zone

Leucopternis princeps, Barred-bellied Leucopternis.
Odontophorus guttatus, Spotted Partridge.
Odontophorus leucolæmus, White-throated Partridge.
Oreopeleia goldmani, Goldman's Quail Dove.
Claravis mondetoura, Mondétour's Ground Dove.
Urochroma dilectissima, Blue-fronted Parrotlet.
Pyrrhura hoffmanni gaudens, Chiriqui Paroquet.
Dryobates villosus extimus, Boquete Woodpecker.
Aulacorhynchus cæruleogularis cæruleogularis, Blue-throated Toucanet.
Aulacorhynchus cæruleogularis cognatus, Darien Blue-throated Toucanet.
Pharomachrus mocinno costaricensis, Costa Rican Quetzal.
Otus nudipes, Bare-legged Screech Owl.
Nesophlox bryantæ, Costa Rican Wood-Star.
Selasphorus scintilla, Scintillant Hummingbird.
Eugenes spectabilis, Admirable Hummingbird.
Panterpe insignis, Irazu Hummingbird.
Oreopyga castaneoventris castaneoventris, Chiriqui Mountain Gem.
Colibri cyanotus, Lesser Violet-Ear.
Callipharus nigriventris, Black-bellied Hummingbird.
Eupherusa egregia, Egregious Hummingbird.
Hemistephania veraguensis, Veraguan Lance-Bill.
Goethalsia bella, Goethals' Hummingbird.

Eriocnemis floccus, Wool-tufted Hummingbird.
Phæthornis guy coruscus, Bangs' Hermit.
Dendrocolaptes validus costaricensis, Costa Rican Woodhewer.
Rhopoctites rufobrunneus, Streaked Automolus.
Xenicopsis subalaris lineatus, Lineated Xenicopsis.
Philydor panerythrus, Ochraceous Philydor.
Pseudocolaptes lawrencii, Lawrence's Pseudocolaptes.
Acrorchilus erythrops rufigenis, Lawrence's Spinetail.
Premnoplex brunnescens brunneicauda, Costa Rican Premnoplex.
Margarornis rubiginosa, Costa Rican Margarornis.
Margarornis bellulus, Beautiful Margarornis.
Xenops rutilus heterurus, Streaked Xenops.
Grallaricula costaricensis, Costa Rican Grallaricula.
Grallaricula flavirostris brevis, Darien Grallaricula.
Formicarius rufipectus, Rufous-breasted Antthrush.
Dysithamnus mentalis suffusus, Olive-sided Antvireo.
Scytalopus argentifrons, Silvery-fronted Scytalopus.
Idiotriccus zeledoni, Zeledon's Tyrannulet.
Cephalopterus glabricollis, Bare-necked Umbrella Bird.
Myiochanes lugubris, Lugubrious Flycatcher.
Elænia frantzii frantzii, Frantzius' Elænia.
Pseudotriccus pelzelni berlepschi, Berlepsch Flycatcher.
Myadestes coloratus, Varied Solitaire.
Myadestes melanops, Black-faced Solitaire.
Planesticus plebejus, Cabanis' Thrush.
Catharus frantzii frantzii, Frantzius' Nightingale Thrush.
Catharus griseiceps, Gray-headed Nightingale Thrush.
Catharus fuscater mirabilis, Darien Nightingale Thrush.
Zeledonia coronata, Wren-Thrush.
Cinclus ardesiacus, Costa Rican Dipper.
Henicorhina leucophrys collina, Chiriqui Wood Wren.
Troglodytes festinus, Mount Pirre Wren.
Troglodytes ochraceus, Irazu Wren.
Cyanolyca argentigula, Silver-throated Jay.
Vireosylva josephæ chiriquensis, Chiriqui Vireo.
Vireo carmioli, Carmiol's Vireo.
Basileuterus melanotis, Black-eared Warbler.
Basileuterus melanogenys ignotus, Mount Pirre Warbler.
Myioborus torquatus, Collared Redstart.
Myioborus aurantiacus, Yellow-bellied Redstart.
Oreothlypis gutturalis, Irazu Warbler.
Chrysothlypis chrysomelas ocularis, Black and Gold Tanager.
Tangara icterocephala, Silver-throated Tanager.
Tangara fucosus, Green-naped Tanager.
Chlorospingus novicius novicius, Bangs' Tanager.
Chlorophonia callophrys, Costa Rican Chlorophonia.
Hylospingus inornatus, Mount Pirre Tanager.
Caryothraustes canadensis simulans, Black-masked Finch.
Pheucticus tibialis, Irazu Grosbeak.
Pezopetes capitalis, Large-footed Sparrow.
Pselliophorus tibialis, Yellow-thighed Sparrow.
Buerremon brunneinuchus, Chestnut-capped Buerremon.
Atlapetes gutturalis, Yellow-throated Sparrow.
Lysurus crassirostris, Barranca Sparrow.
Brachyspiza capensis peruviana, Peruvian Sparrow.

Plants of Upper Tropical Zone

Lycopodium stamineum.
Lycopodium tortile.
Lycopodium foliaceum.
Lycopodium lancifolium.
Lycopodium cuneifolium.
Lycopodium subulatum.
Lycopodium podocarpum.
Lycopodium watsonianum.
Marattia pittieri.
Anthurium joseanum.
Monstera parkeriana.
Monstera pertusa.
Piper pseudopropinquum.
Quercus warscewiczii.
Quercus bumelioides.
Quercus chiriquensis, Chiriqui Oak.
Cecropia maxoni, Maxon's Guarumo.
Loranthus densiflorus.
Phoradendron corynarthron.
Phoradendron nervosum.
Desmopsis maxonii.
Persea veraguensis.
Prunus occidentalis.
Rubus floribundus.
Lupinus clarkii.
Macherium seemannii.
Meibomia maxoni.
Euphorbia barbellata.
Euphorbia graminea.
Triumfetta speciosa.

Malache maxoni.
Centrademia inaequilateralis.
Miconia caudata.
Monchaetum bracteolatum.
Lopezia pariculata.
Symplocos chiriquensis.
Lamourouxia gutierrezii.
Begonia chiriquina.
Begonia brevicyma.
Begonia seemanniana.
Begonia setosa.
Begonia stigmosa.
Dicliptera iopus.
Geissomeria lolioides.
Justicia glabra.
Deppea longipes.
Hoffmannia pittieri.
Nertera depressa.
Palicourea chiricana.
Psychotria aggregata.
Psychotria anomothyrsa.
Psychotria chiricana.
Psychotria goldmanii.
Psychotria panamensis.
Rondeletia affinis.
Rondeletia laniflora.
Rondeletia versicolor.
Sommera mesochora.
Senecio arborescens.

TEMPERATE ZONE

The Volcan de Chiriqui was not visited by me and has been very incompletely explored by others. Conditions on the upper slopes are apparently analogous to those known to obtain in similar regions elsewhere in Middle America. There seems to be a diminution in moisture above about 8,000 feet altitude and temperatures below the freezing point are registered near the summit. Mr. Henry Pittier,[1] who has visited the Volcan de Chiriqui, describes conditions on the very similar mountains in Costa Rica and points out changes in the forest above an altitude of 2,600 meters. The trees become progressively reduced in size, with short trunks and widely spreading branches, and at about 3,000 meters, although still dense and covering extensive areas on the slopes, no longer deserve the name of forest. The Lauraceae, species of *Podocarpus, Talauma* and even *Quercus* have disappeared and are replaced by Ericaceae, Mirtaceae, Miricaceae and other groups. Mr. Outram Bangs,[2] quoting the field notes of Mr. W. W. Brown, Jr., who collected birds and mammals on the mountain, says:

> At 10,000 feet the character of the forest changes decidedly, the trees become low and stunted, their trunks and branches are thickly covered with cold, saturated moss. On some of the branches globular formations of moss give an odd appearance to the tree. The undergrowth is chiefly of berry-bearing shrubs and two species of cane, with ferns and flowering herbs.
>
> One shrub produces a berry about the size of a cherry, which has a rich flavor, and of which doves and big Merula (*M. nigrescens*) are very fond. At 11,000 feet the forest ends, and at the timber line the characteristic species are the Junco (*Junco vulcani*), a big-footed finch (*Pezopetes capitalis*), the long-tailed ptilogonys and a curious little wren with peculiar notes, that lives in the cane brakes (*Troglodytes browni*). The country is open, broken, barren and very rocky, but there is a growth of low huckleberry-like shrubs that average 10 inches in height and are literally black with berries. There are also low flowering plants, and some tiny ferns, different from any seen below.

[1] Ensayo Sobre las Plantas Usuales de Costa Rica, 1908.

[2] The Auk, Vol. 3, p. 18, Jan. 30, 1902.

Standing up high above this desolate region is the great rocky peak of Mt. Chiriqui, which I believe I am the only man to have climbed. The summit is a towering rock, its extreme point so sharp and narrow that I had to straddle it. Under one foot was a sheer fall of some 900 feet, under the other a sharp slope of 600 or 700. I found no signs of any previous ascent, but left two records of my own visit. From the top I looked down on the waters of the Caribbean Sea and of the Pacific Ocean, seeing distinctly the indentations of both coasts. To the west I could see the Costa Rican Mountains, and to the east stretched an ocean of small peaks. My aneroid registered 11,500 feet.

This zone seems to be representative of the several boreal life zones recognizable in North America, but its exact relation to them remains to be determined.

Mammals of Temperate Zone

Reithrodontomys australis australis, Irazu Harvest Mouse (occurs also in upper Tropical Zone).
Reithrodontomys creper, Chiriqui Harvest Mouse.
Scotinomys xerampelinus, Chiriqui Brown Mouse.
Sigmodon austerulus, Chiriqui Cotton Rat.

Birds of Temperate Zone

Chlorœnas albilinea crissalis, Costa Rican Band-tailed Pigeon.
Selasphorus torridus, Heliotrope-throated Hummingbird.
Casmarhinchos tricarunculatus, Costa Rican Bell-Bird.
Empidonax atriceps, Black-capped Fly-catcher.
Planesticus nigrescens, Sooty Thrush.
Catharus gracilirostris accentor, Chiriqui Nightingale Thrush.
Thryorchilus browni, Brown's Wren.
Ptilogonys caudatus, Costa Rican Ptilogonys.
Phainoptila melanoxantha, Salvin's Ptil-ogonys.
Basileuterus melanogenys eximius, Chiriqui Warbler.
Diglossa plumbea, Costa Rican Diglossa.
Chlorospingus pileatus, Sooty-capped Chlo-rospingus.
Junco vulcani, Volcan Junco.

Plants of Temperate Zone

Lycopodium chiricanum.
Lycopodium hippuridium.
Dendrophthora biserrula.
Dendrophthora costaricensis.
Dendrophthora wrightii.
Maytenus blepharodes.
Arcytophyllum lavarum.

LIST OF THE MAMMALS OF PANAMA

Chironectes panamensis.
Didelphis marsupialis etensis.
Didelphis marsupialis particeps.
Didelphis marsupialis battyi.
Marmosa mexicana isthmica.
Marmosa mexicana savannarum.
Marmosa fulviventer.
Marmosa invicta.
Metachirus opossum fuscogriseus.
Metachirus nudicaudatus dentaneus.
Philander laniger derbianus.
Philander laniger pallidus.
Philander laniger nauticus.
Peramys melanops.
Bradypus griseus griseus.
Bradypus ignavus.
Cholœpus hoffmanni.
Cyclopes didactylus dorsalis.
Tamanduas tetradactyla chiriquensis.
Myrmecophaga tridactyla centralis.
Dasypus novemcinctus fenestratus.
Cabassous centralis.
Trichechus manatus.
Pecari angulatus crusnigrum.
Pecari angulatus bangsi.
Tayassu pecari spiradens.
Odocoileus chiriquensis.
Odocoileus rothschildi.

Mazama sartorii reperticia.
Tapirella bairdii.
Reithrodontomys australis australis.
Reithrodontomys creper.
Reithrodontomys mexicanus cherrii.
Peromyscus flavidus.
Peromyscus pirrensis.
Peromyscus nudipes.
Nyctomys sumichrasti nitellinus.
Rhipidomys scandens.
Tylomys panamensis.
Tylomys watsoni.
Tylomys fulviventer.
Scotinomys teguina apricus.
Scotinomys xerampelinus.
Zygodontomys cherriei cherriei.
Zygodontomys cherriei ventriosus
Zygodontomys seorsus.
Neacomys pictus.
Oryzomys gatunensis.
Oryzomys alfaroi alfaroi.
Oryzomys alfaroi dariensis.
Oryzomys bombycinus bombycinus.
Oryzomys talamancæ.
Oryzomys devius.
Oryzomys pirrensis.
Oryzomys tectus tectus.
Oryzomys tectus frontalis.
Oryzomys fulvescens costaricensis.
Oryzomys fulvescens vegetus.
Oryzomys caliginosus idoneus.
Oryzomys caliginosus chrysomelas.
Nectomys alfari efficax.
Sigmodon hispidus chiriquensis.
Sigmodon austerulus.
Rheomys raptor.
Rattus rattus rattus.
Rattus rattus alexandrinus.
Mus musculus musculus.
Macrogeomys dariensis.
Macrogeomys cavator.
Macrogeomys pansa.
Heteromys australis conscius.
Heteromys desmarestianus repens.
Heteromys desmarestianus zonalis.
Heteromys desmarestianus panamensis.
Heteromys desmarestianus crassirostris.
Liomys adspersus.
Proechimys semispinosus panamensis.
Proechimys semispinosus burrus.
Hoplomys gymnurus goethalsi.
Diplomys labilis.
Diplomys darlingi.
Dasyprocta punctata isthmica.
Dasyprocta punctata dariensis.
Dasyprocta punctata nuchalis.
Dasyprocta callida.
Dasyprocta coibæ.
Cuniculus paca virgatus.
Hydrochœrus isthmius.
Coendou mexicanum lænatum.
Coendou rothschildi.
Sciurus variegatoides helveolus.
Sciurus variegatoides melania.
Sciurus hoffmanni chiriquensis.
Sciurus gerrardi choco.
Sciurus gerrardi morulus.
Microsciurus boquetensis.
Microsciurus alfari browni.
Microsciurus alfari venustules.
Microsciurus isthmius vivatus.
Syntheosciurus brochus.
Sylvilagus gabbi gabbi.
Sylvilagus gabbi messorius.
Sylvilagus gabbi incitatus.
Sylvilagus gabbi consobrinus.
Icticyon panamensis.
Bassariscus sumichrasti notinus.
Procyon cancrivorus panamensis.
Procyon lotor pumilus.
Nasua narica panamensis.
Bassaricyon gabbii gabbii.
Bassaricyon gabbii orinomus.
Potos flavus isthmicus.
Potos flavus chiriquensis.
Mustela affinis costaricensis.
Tayra barbara biologiæ.
Grison canaster.
Conepatus tropicalis trichurus.
Lutra repanda.
Felis onca centralis.
Felis pardalis mearnsi.
Felis pirrensis.
Felis bangsi costaricensis.
Herpailurus yagouaroundi panamensis.
Cryptotis merus.
Rhynchiscus naso priscus.
Saccopteryx bilineata bilineata.
Saccopteryx leptura.
Peropteryx canina canina.
Centronycteris centralis.
Diclidurus virgo.
Dirias albiventer minor.
Chilonycteris rubiginosa rubiginosa.
Micronycteris microtis.
Lonchorina aurita.
Tonatia amblyotis.
Macrophyllum macrophyllum.
Phyllostomus hastatus panamensis.
Trachops cirrhosus.
Vampyrus spectrum nelsoni.
Glossophaga soricina leachii.
Lonchophylla robusta.
Lonchophylla concava.
Hemiderma perspicillatum aztecum.
Hemiderma castaneum.
Sturnira lilium parvidens.
Uroderma bilobatum.
Vampyrops helleri.
Vampyrodes major.
Vampyressa minuta.
Chiroderma isthmicum.
Chiroderma salvini.
Artibeus watsoni.
Artibeus jamaicensis jamaicensis.
Artibeus planirostris planirostris.

Desmodus rotundus murinus.
Diphylla centralis.
Natalus mexicanus.
Myotis nigricans.
Myotis ———— sp.?
Eptesicus propinquus.
Eptesicus fuscus miradorensis.
Nycteris borealis mexicana.
Dasypterus ega panamensis.
Rhogeëssa tumida.
Molossops planirostris.
Eumops nanus.
Eumops glaucinus.
Molossus coibensis.
Molossus sinaloae.
Molossus bondae.
Saimiri örstedii örstedii.
Aotus zonalis.
Leontocebus geoffroyi.
Alouatta palliata inconsonans.
Alouatta coibensis.
Cebus capucinus capucinus.
Cebus capucinus imitator.
Ateles geoffroyi.
Ateles dariensis

GENERAL ACCOUNT OF THE MAMMALS

Class **MAMMALIA**

Order MARSUPIALIA. Marsupials

Family **DIDELPHIIDAE.** Opossums

The opossums, which constitute the only large American family of existing Marsupials,[1] are represented in Panama by six genera. They vary in type from the large familiar opossum of the southeastern United States to the woolly opossums, the web-footed water opossum, and species so small that ordinary observers often mistake them for rats or mice. The small species, to which the rather misleading term "murine" is often applied, may perhaps be most easily recognized as opossums by the wide mouth and numerous teeth visible, the opposibility of the toes, and the remarkable resemblance to hands exhibited by both fore and hind feet. The American Marsupials are as a group essentially tropical in distribution, although one or two species push well northward into the temperate zone in North America and ascend to the upper slopes of high mountains in Middle America.

Genus **CHIRONECTES** Illiger

The water opossums are distinguished from the other opossums by black and gray marbled dorsal markings, the rounded black areas confluent along the median line of the back. The fur is dense, somewhat like that of an otter; the hind feet are completely webbed and the animal generally fitted for an aquatic life. In general structure *Chironectes* is very similar, however, to the other opossums. It was regarded by Thomas [2] as most nearly related to the genus *Metachirus*.

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[1] The other existing American family of the order, Cænolestidæ, includes the aberrant genera *Cænolestes* and *Orolestes* which are restricted to South America.

[2] Cat. Marsup. Brit. Mus., p. 366, 1888.



FIG. 1.—Chiriqui White-tailed Deer (*Odocoileus chiriquensis*) now ranging throughout much of the Canal Zone as far north as the Atlantic Coast.



FIG. 2.—Allen's Opossum (*Metachirus opossum fuscogriseus*), caught in trap placed at base of tree in forest near Gatun, Canal Zone.



Darien Pocket Gopher (*Macrogeomys dariensis*) at mouth of one of its tunnels near Cana, eastern Panama, altitude 2,000 feet.

CHIRONECTES PANAMENSIS Goldman

Panama Water Opossum

[Plate 20, figs. 2, 2*a*]

Chironectes panamensis GOLDMAN, Smiths. Misc. Coll., Vol. 63, No. 5, p. 1, March 14, 1914. Type from Cana, eastern Panama, altitude 2,000 feet.

The water opossums are little known. They occur in suitable localities entirely across South America and northward through Middle America to Tuxtla Chico in extreme southern Mexico, but are rare, and few specimens have found their way into museum collections. A specimen from Cana, eastern Panama, has been made the type of a species apparently differing from *C. minimus* of northeastern South America mainly in various cranial details, especially the longer, evenly tapering and posteriorly pointed, instead of truncate, nasals. The type was caught in a steel trap baited with fish and set beneath the surface of the water in a small rock-bordered stream at 2,000 feet altitude. In Brazil, according to Waterhouse,[1] " two of Dr. Natterer's specimens, that gentleman informed me, were caught near water not far from Rio Janeiro, and a third was captured in the water, alive, near Para, in a basket similar to those used for catching eels in this country: it had made its way through the funnel-shaped opening, and could not return; thus proving that the animals are good divers. They feed upon crustaceans, and no doubt upon other aquatic animals."

Specimens examined: Aside from the type mentioned, no specimens of *Chironectes panamensis* have been recorded from Panama, but ten examples have been examined by me from localities in Colombia, Costa Rica and Nicaragua.

Genus DIDELPHIS Linnæus

The typical genus of the family includes the largest species of the region, the type of animal that inhabits the southeastern United States. The forms are externally distinguished from the other opossums by the coarse hair, or bristles, which project conspicuously beyond the shorter and softer under fur.

DIDELPHIS MARSUPIALIS ETENSIS Allen

Eten Opossum; Zorro

Didelphis marsupialis etensis ALLEN, Bull. Amer. Mus. Nat. Hist., Vol. 16, p. 262, August 18, 1902. Type from Eten, Piura, Peru.

Large opossums of the common coarse-haired *Didelphis virginiana* type are abundant nearly throughout the region. The status of the

[1] Nat. Hist. Mamm., Vol. 1, p. 535, 1846.

continental form is not, however, entirely clear; specimens examined, as remarked by Allen (*l. c.*), seem "not apparently distinguishable" from typical *D. m. etensis*. On the other hand they are not very unlike typical examples of the apparently larger subspecies *D. m. richmondi* of Nicaragua, and may be somewhat intermediate in general characters. As in other forms of the general group two color phases are shown. The usual color of the pelage is blackest at the tips, but in about one-third of the individuals examined, long whitish hairs are predominant among the black ones. This dichromatism has led to the belief in many localities that two distinct species exist side by side.

While this form may be said to be abundant it occurs in smaller numbers at most localities than *Metachirus opossum fuscogriseus*. It favors the vicinity of streams or other water, along the muddy borders of which numerous palmate tracks may be seen. While using a hunting lamp in quest of more important game a number were shot at night along the banks of streams. The species is easily taken in steel traps baited with meat or fruit, especially bananas, of which they are very fond. When caught the ground and vegetation within reach are thoroughly torn up by the animal in frantic struggles to free itself, but on hearing some one approach it instantly becomes quiescent and "possums" in the characteristic manner. The body becomes motionless, in a half-crouched position, the head drops slightly, and unless the eyeballs are touched the eyes have a fixed stare. Given a slight push the opossum tumbles over on its side and lies with rigid limbs and muscles as though dead. In this condition it may be handled freely, making no attempt to bite or even to stir and about the only sign of life is its regular breathing. Removed from the trap it may be left lying motionless and apparently dead upon the ground. But it is sure to be gone if the trapper retires and returns to search for it a few minutes later.

A female trapped at Gatun had five hairless and sightless young all firmly attached to teats within her pouch. When the young were forcibly drawn away the much elongated teats were seen to have extended well into their throats. Several other litters of similar young were examined. The lips seem to be practically immobile; the mouth a very small, round opening into which the teat fits so snugly that one wonders how it could have been introduced at the time of the birth of so embryonic an animal. When the young are detached the open mouth retains the shape of the teat; they begin at once to show their discomfort by making a slight hissing noise,

twisting their limbs and bodies about and rolling over and over on the ground. In this pitiful condition they may live for hours.

Several stomachs of opossums shot at night were examined and found to contain the remains of crabs and small quantities of some unidentifiable fruit. It is evident that crabs are an important element of the diet of these animals, at least near the seacoasts.

Under the name *Didelphis richmondi,* Bangs (1902, p. 19) noted specimens collected by W. W. Brown, Jr., at Boquete. Later in the same year Allen (*l. c.*) recorded 33 examples from Boqueron and a smaller series from Boquete, all taken by J. H. Batty. Specimens probably referable to this form were listed as *Didelphis marsupialis* by Thomas (1903*a,* p. 42) from Sevilla, Afuera, Gobernador, Tologa, Brava and Cebaco, all small islands off the southern coast of western Panama. He adds "as on the mainland, these island opossums differ much among themselves, but none are as uniformly brown-faced as the Coiba form *D. m. battyi.*" Anthony (1916, p. 364) regarded the species as not uncommon in the Canal Zone, but rarer in the Darien region. He recorded specimens from Boca de Cupe, Cituro, Real de Santa Maria and Gatun.

Through a peculiar transposition of names "zorro" for the male and "zorra" for the female, commonly and more properly applied by the people to the foxes in much of Middle America, are used instead for the opossums in Panama and Costa Rica. While the termination employed depends usually on the sex of individuals the masculine form is used in a generic sense to designate the species, or an individual whose sex is unknown. In Costa Rica where foxes occur they have received the misnomer "tigrillo" (little tiger).

Specimens examined: Ancon, 1; Boca de Cupe, 1[1]; Boqueron, 18[1]; Boquete, 7[2,4]; Cana, 8; Cituro, 1[1]; Empire, 3; Gatun, 13[3]; Lion Hill, 2; Mount Pirre, 1; Porto Bello, 1; Real de Santa Maria, 1.[1]

DIDELPHIS MARSUPIALIS PARTICEPS Goldman

San Miguel Island Opossum

Didelphis marsupialis particeps GOLDMAN, Proc. Biol. Soc. Washington, Vol. 30, p. 107, May 23, 1917. Type from San Miguel Island, Bay of Panama.

In recording two opossums from San Miguel Island as *Didelphis karkinophaga caucæ* Allen, Bangs (1906, p. 633) remarks: "These

[1] Collection Amer. Mus. Nat. Hist.

[2] Six specimens in Mus. Comp. Zool.

[3] Five specimens in Amer. Mus. Nat. Hist.

[4] One specimen in Amer. Mus. Nat. Hist.

have been compared by Dr. J. A. Allen with extensive material from South and Central America; and it is Dr. Allen's opinion that they are best referred to this form, though they do not represent it in its extremes." Later studies have led to the recognition of these as representing an insular race with less blackish face and skull characterized by relatively broader rostrum, narrower braincase and posteriorly expanded zyzomata in comparison with the form inhabiting the adjacent mainland.

Specimens examined: San Miguel Island, 2.[1]

DIDELPHIS MARSUPIALIS BATTYI Thomas

Batty's Opossum

Didelphis marsupialis battyi Thomas, Novitates Zoologicæ, Vol. 9, p. 137, April, 1902. Type from Coiba Island, Panama.

Batty's opossum is described as a rather small dark-faced insular race. It was originally compared with *D. m. caucæ* of Colombia, but is probably most nearly allied to the form inhabiting the adjacent mainland.

Allen (1902, p. 264) in his review of the group, after quoting the original description, says, "*D. m. battyi* seems to represent a small insular race, as shown by several topotypes kindly presented by the collector, Mr. J. H. Batty, to this Museum. I am also indebted to Mr. Batty's kindness for a transcript from his note-book of the measurements of the specimens taken before skinning. I am thus able to supplement Mr. Thomas's description with the flesh measurements of not only his type, but also of seven additional specimens. . . . . The four females, rather strangely, happen to range rather larger than the four males, doubtless owing to the fact that the females had reached a greater maturity than the males. If the females of the Coiba Island series and the females of the Boqueron and Boquete series [referred by him to *D. m. etensis*] be taken as the basis of comparison, the apparent difference in size practically vanishes." Specimens examined by me are somewhat darker on the face than *etensis* as represented at Boqueron on the adjacent mainland.

Specimens examined: Coiba Island, 3.

Genus MARMOSA Gray

The genus *Marmosa* includes a number of small, slender, long-tailed species commonly termed "Murine" opossums, owing to a very superficial resemblance to rats. They are rat-like, however,

[1] Specimens in Mus. Comp. Zool.

only in size, as a glance at the wide mouth, numerous teeth, and characteristically opossum feet show. The skull of *Marmosa* is similar to that of *Philander* in the permanent separation of the temporal ridges, but it differs in other important respects, especially the absence of distinct postorbital processes, the straight and anteriorly much converged maxillary toothrows, and in the relative size of the first and third upper molars. In *Marmosa* the third upper molar is larger than the first, while in *Philander* the reverse is usually true. For many years a single form was supposed to range northward from South America to southern Mexico, but several distinct species are now known to inhabit Middle America.

MARMOSA MEXICANA ISTHMICA Goldman

Isthmian Marmosa

[Plate 21, figs. 3, 3*a*]

Marmosa isthmica GOLDMAN, Smiths. Misc. Coll., Vol. 56, No. 36, p. 1, February 19, 1912. Type from Rio Indio, near Gatun, Canal Zone, Panama.

The isthmian marmosa is about the size of a large rat. It closely resembles *M. mitis* Bangs, of the Santa Marta region of Colombia, in color, but differs from that animal in larger size, relatively larger braincase, broader interorbital space and actually smaller audital processes of alisphenoids. The general color of the upperparts is brownish cinnamon (about sayal brown of Ridgway, 1912), lighter on the middle of the face, and becoming dull ochraceous buff on the sides of the neck and flanks; the underparts are between pinkish buff and cream buff. It is probably a common species throughout Panama. The type was trapped in an old banana plantation only a few feet above sea level near Gatun. At Cana, where the opossums are fairly abundant, a number of specimens were caught in banana-baited traps set on hanging bunches of the ripening fruit in a plantation. The bunches of fruit were visited by the opossums nearly every night. Other specimens were taken in dense undergrowth on the ground in old clearings.

Under the name *Didelphys murina,* Alston (1879, p. 200) notes a small opossum which may have been this form collected by Arcé in Veragua. A specimen of this subspecies was recorded by Bangs (1902, p. 19) as *Marmosa mexicana* from Boquete, Chiriqui. More recently a large series, in the aggregate, of this opossum has been recorded by Anthony (1916, p. 363) from Real de Santa Maria, Gatun, Maxon Ranch (Rio Trinidad), Tapalisa and Tacarcuna. All of these localities are in the eastern half of Panama, ranging from

near sea level to over 4,000 feet in altitude. Anthony noted the fact that the males were much larger than the females.

Specimens examined: Boquete, 1 [1]; Cana, 14; Gatun, 7 [2]; Maxon Ranch (Rio Trinidad), 2 [2]; Real de Santa Maria, 4 [2]; Rio Indio (type locality), 1; Tacarcuna (2,650-4,200 feet), 33 [2]; Tapalisa, 2.[2]

MARMOSA MEXICANA SAVANNARUM Goldman

Savanna Marmosa

Marmosa mexicana savannarum GOLDMAN, Proc. Biol. Soc. Washington, Vol. 30, p. 108, May 23, 1917. Type from Boqueron, Chiriqui, Panama.

Specimens of this little opossum were recorded by Bangs (1902, p. 19) as *Marmosa mexicana* from Bugaba, and by Allen (1904, p. 56) as *Marmosa murina mexicana* from Boqueron, Chiriqui. On comparison with subsequent accessions of material from various localities these specimens appear to represent a geographic race distinguished by small size and pale coloration, the latter character shared with other mammals inhabiting the same generally open savanna region, and evidently the result of the environmental conditions prevailing. This pallid subspecies may range along the Pacific coast of Panama as far east as the Bayano River where the savannas end abruptly.

Specimens examined: Boqueron, 2 [2]; Bugaba, 3.[1]

MARMOSA FULVIVENTER Bangs

Fulvous-bellied Marmosa

Marmosa fulviventer BANGS, Amer. Nat., Vol. 35, p. 632. August, 1901. Type from San Miguel Island, Panama.

The fulvous-bellied marmosa is an insular representative of the group to which *M. isthmica* Goldman of the adjacent mainland belongs. It differs from that animal in darker color, the underparts being deep buff or fulvous instead of cream buff or pinkish buff. It is known only from five specimens collected on the islands of San Miguel and Saboga by W. W. Brown, Jr., in the spring of 1900.

The example from Saboga, a small island in the northern part of the archipelago, is slightly paler throughout than specimens from San Miguel and may represent an unrecognized form. The incomplete skull, however, is not very appreciably different.

Specimens examined: Saboga Island, 1 [1]; San Miguel Island, 4.[1]

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[1] Collection Mus. Comp. Zool.

[2] Collection Amer. Mus. Nat. Hist.

MARMOSA INVICTA Goldman

Black Marmosa

[Plate 21, figs. 2, 2*a*]

Marmosa invicta Goldman, Smiths. Misc. Coll., Vol. 60, No. 2, p. 3, September 20, 1912. Type from Cana, eastern Panama (altitude 2,000 feet).

A blackish species of pygmy opossum, mouse-like in size and superficial appearance, was discovered at Cana, in the mountains of eastern Panama. The marsupial pouch is absent as usual in the genus. The mammae in an adult female were enclosed in a cinnamon brownish abdominal area. Examination before skinning showed the mammae, five in number, irregularly placed, three being ranged in a row on the right side, one on the left, and the other on the median line. Two specimens only were obtained, both of them at the same locality in traps placed among rocks in second growth forest.

This species has no known near relative in Middle America, but may be allied to some of the South American forms of the large unrevised genus to which it belongs.

Specimens examined: Two from the type locality.

Genus METACHIRUS Burmeister

The members of this genus are of medium size, the pelage short, rather straight, without the projecting bristles present in *Didelphis,* and lacking the long lax woolly quality of the pelage of *Philander.* With advancing age the temporal ridges unite to form a high, trenchant sagittal crest similar to that developed somewhat earlier in *Didelphis.* Two species range into Panama.

METACHIRUS OPOSSUM FUSCOGRISEUS Allen

Allen's Opossum; Zorro

Metachirus fuscogriseus Allen, Bull. Amer. Mus. Nat. Hist., Vol. 13, p. 194, October 23, 1900. Type locality, Greytown, Nicaragua.[1]

Of the several species of opossums inhabiting the region this form is by far the most abundant at low elevations. It is about the same in size, and in general appearance resembles its Panama congener, *Metachirus nudicaudatus dentaneus,* by which it is largely replaced on the upper slopes of the mountains. It differs, however, in dark grayish instead of brownish general coloration, and the light markings on the head are grayish instead of ochraceous buffy. The two

[1] Type locality fixed by Allen, Bull. Amer. Mus. Nat. Hist., Vol. 30, p. 247, Dec. 2, 1911.

species occur together at low elevations, but are very distinct as shown by important cranial characters.

A number of specimens were caught in traps set in the hope of attracting more important game. Several shot at night along the banks of streams were located by their shining eyes as seen under the glare of a hunting lamp. Unlike *Didelphis* when taken in steel traps these opossums are always ready to fight savagely. The stomach of one taken at Gatun was well filled with fragments of crabs. Fragments of birds alone, or of birds, including their feathers, and crabs intermixed, were the stomach contents of several others at the same locality. These limited observations indicate that birds suffer much from the depredations of the opossums. A female obtained carried five young in her pouch; although they were small they did not seem to cling so closely to the teats as similar young of *Didelphis.*

A nest of one of these opossums was found three feet from the ground on a fallen log. The log lay in the dense thicket of an old clearing and was heavily overhung with vines and bushes. The nest, globular in form and about a foot in diameter, was placed in a well-hidden spot among the vines. It was made entirely of the banana-like leaves of a native plant rather neatly laid together. The opening at one end faced outward along the log. The occupant slipped quietly out of the nest, when I was within three feet, ran rapidly along the log and disappeared in the thick vegetation. The nest cavity was clean and about the size of the animal's body.

In his original account of *M. o. fuscogriseus,* Dr. Allen (*l. c.*) gave the type region as " Central America " and stated that " the locality of the type of *M. fuscogriseus* is unfortunately not definitely known; the specimen was found in a bunch of bananas in unloading a fruit steamer from a Central American port, most likely Colon." In view of his indefinite reference to Colon and the fact that Panama and Nicaragua appear to be inhabited by the same form I accept his later fixation of the type locality. It is probably not very unusual for animals of this general group to be carried away among bunches of bananas. For example, a specimen of a large species of *Marmosa* was transshipped and carried to an interior point in Texas before being discovered.

Bangs (1902, p. 19) recorded specimens collected by W. W. Brown, Jr., at Boquete and Bugaba, Chiriqui. The species was noted by Thomas (1903*a*, p. 42) from Sevilla Island off the south coast of western Panama. Allen (1904, p. 57) states that Boqueron specimens collected by J. H. Batty " agree well with the type of

M. fuscogriseus, which, however, proves to have been a young adult that had not reached full size. The males have a patch (probably glandular) of pale greenish yellow on each side of the flanks just in front of the thighs; in the females the fur around the edge of the pouch, and also lining it, is bright rusty chestnut." Anthony (1916, p. 363) records a specimen taken by him at Gatun.

The native name *zorro* is applied to this species and to all of the other large opossums inhabiting the region.

Specimens examined: Bugaba, 3[1]; Boqueron, 5[2]; Boquete, 1[1]; Buenaventura Island (near Porto Bello), 1; Empire, 4; Gatun, 12[3]; Tabernilla, 3.

METACHIRUS NUDICAUDATUS DENTANEUS Goldman

Brown Opossum; Zorro

[Plate 20, figs. 1, 1*a*]

Metachirus nudicaudatus dentaneus GOLDMAN, Smiths. Misc. Coll. Vol. 56, No. 36, p. 3. February 19, 1912. Type from Gatun, Canal Zone, Panama.

In size and superficial appearance this opossum resembles *Metachirus opossum fuscogriseus,* but is distinguishable by brown instead of dark grayish general coloration, and by ochraceous buffy instead of plain grayish light areas on the head.

It occurs sparingly at low elevations where *M. o. fuscogriseus* is an abundant species, but apparently becomes more numerous and largely replaces that animal on the middle slopes of the mountains. The general habits of the two appear to be the same, and both are northern representatives of widely ranging South American species.

Specimens are recorded by Anthony (1916, p. 364) from Gatun, Maxon Ranch (Rio Trinidad), 3; Tacarcuna, 2.

Specimens examined: Cana, 4; Cerro Azul, 1; Gatun (type locality), 5[4]; Maxon Ranch (Rio Trinidad), 1[2]; Tacarcuna, 2.[2]

Genus PHILANDER Brisson

The opossums of this genus are handsome animals of about the same medium size as *Metachirus,* but may be readily distinguished from that genus by longer, softer, more woolly pelage, and richer, more contrasting colors. The face is marked by a dark median stripe. In *Philander* the temporal ridges remain permanently separate much as in *Marmosa,* but the skull differs notably from that of the latter

[1] Collection Mus. Comp. Zool.

[2] Collection Amer. Mus. Nat. Hist.

[3] One specimen in Amer. Mus. Nat. Hist.

[4] Three in collection Amer. Mus. Nat. Hist.

genus in the well-developed postorbital processes, the arcuate instead of straight and anteriorly much-converged maxillary toothrows, and in important dental details.

PHILANDER LANIGER DERBIANUS Waterhouse

Derby's Woolly Opossum

Didelphys derbianus WATERHOUSE, Jardine's Naturalist's Library, Mamm., Vol. XI, p. 97, 1841. Type region, Cauca Valley, Colombia.[1]

The beautiful woolly opossums of the *Philander laniger* group are distributed throughout much of South America and range northward to southern Mexico. Their more ornate appearance, as compared with the other opossums of the region, has already been indicated in the remarks on the genus.

The specimens from eastern Panama agree fairly well with descriptions and are assumed to represent *P. l. derbianus* which seems to be distinguishable among the subspecies credited to the republic by its rich cinnamon rufescent coloration. This form has a distinct grayish stripe several inches in length on the median line between the shoulders sometimes referred to as the "withers mark."

Derby's opossum appears to be less numerous than the other large species of the region, but this apparent scarcity may be partly due to more arboreal habits. None were caught in traps set on or near the ground where the other species were readily taken. At Cana a specimen obtained by using the hunting lamp at night was located in a tall forest tree by the glare of its eyes in the restricted field of light. At Tabernilla one was discovered in a nest of leaves placed in a tangled mass of vines in the top of a small tree near the edge of the forest. The localities show that *P. l. derbianus* ascends from sea level to at least 1,800 feet altitude on the slopes of the mountains.

Alston (1879, p. 199) noted a specimen in the British Museum obtained by Arcé at Chepo.

Specimens examined: Cana, 1; Tabernilla, 1.

PHILANDER LANIGER PALLIDUS Thomas

Pale Woolly Opossum

Philander laniger pallidus THOMAS, Ann. Mag. Nat. Hist., Ser. 7, Vol. 4, p. 286, October, 1899. Type from Bugaba, Chiriqui, Panama (altitude 800 feet).

As Thomas (*l. c.*) remarks, "This appears to be a pale inornate race of the ordinary brightly marked *Ph. l. derbianus*." Although somewhat variable, some specimens approaching *P. l. derbianus,* the general color is paler and the markings less distinct than in that form.

[1] As restricted by Allen (1904, p. 57) and Thomas (1913, p. 358).

Bangs (1902, p. 19) listed specimens collected by W. W. Brown, Jr., at Bugaba and Divala. Allen (1904, p. 56) provisionally referred to this form nine examples taken by J. H. Batty of which six were from Boqueron and three from Parida Island. The latter series apparently represent the form more recently described as *Philander laniger nauticus.* Of the general collection he says: "No two of the Chiriqui specimens are alike in coloration; all but one distinctly show the pale gray median stripe over the shoulders seen in *derbianus,* but with varying distinctness from very clear and strong to subobsolete, while the sides of the neck and shoulders and the middle dorsal region are rufous, varying in different specimens from light, clear rufous to dark, almost chestnut rufous. The other specimen (one of the Parida Island series) has the whole upperparts bright, nearly uniform rufous, even to the proximal half of the forelegs and the entire hind legs, with no trace of the gray stripe on the shoulders."

As at present known this subspecies may be assigned an indefinite range near the arid Pacific coast in western Panama, but until more material is available its exact relationship to neighboring forms cannot be determined.

Specimens examined: Boqueron, 3[1]; Bugaba, 4[2]; Divala, 2.[2]

PHILANDER LANIGER NAUTICUS Thomas

Insular Woolly Opossum

Philander laniger nauticus Thomas, Ann. Mag. Nat. Hist., Ser. 8, Vol. 12, p. 359, October, 1913. Type from Gobernador Island, off south coast of Panama.

According to the description this insular race is most nearly allied to *Philander l. pallidus* of the adjacent mainland, to which the specimens on which it is based were formerly referred by Thomas (1903*a*, p. 42). The general color is given as "sayal brown." The grayish withers mark or median stripe between the shoulders in *P. l. derbianus* and *P. l. pallidus* is said to be imperceptible.

Philander l. nauticus described recently was based on four specimens from Gobernador (type locality), Brava and Cebaco, all small islands close to the southwestern coast of Panama. Under the name *Caluromys laniger pallidus,* Allen (1904, p. 56) recorded three specimens from Parida Island which are probably referable to this race, although one only lacks all trace of the shoulder stripe.

Specimens examined: Parida Island, 3.[1]

[1] Collection Amer. Mus. Nat. Hist.

[2] Collection Mus. Comp. Zool.

Genus PERAMYS Lesson

The tiny opossums of this genus are characterized by short ears and limbs, and very short, apparently non-prehensile tails.

PERAMYS MELANOPS Goldman

Panama Peramys

[Plate 21, figs. 1, 1*a*]

Peramys melanops Goldman, Smiths. Misc. Coll., Vol. 60, No. 2, p. 2, September 20, 1912. Type from Cana, eastern Panama (altitude 2,000 feet).

The short-tailed opossums of the genus *Peramys* are apparently rare in Panama. The type and only known specimen of *P. melanops* is a small but robust animal with a non-prehensile tail less than two and one-half inches in length. The upperparts are plain and very dark brown in general color, the dorsal stripes, or spots, present in some South American species being absent.

The type specimen was taken in a trap set among rocks in the heavy forest on the bank of the Cana River.

Order EDENTATA. Edentates

Family BRADYPODIDAE. Three-toed Sloths

The three-toed sloths are strictly arboreal animals with short, rounded heads, rudimentary tails, and sharp, strongly curved, hook-like claws with which they hang back downward from the branches of trees. The fore limbs are provided with three instead of two digits as in Choloepodidae. The pelage of the top of the head is inclined forward and forms a frontal ruff. The anterior teeth in the upper jaw are reduced in size until they are the smallest of the series and only slightly functional. The anterior teeth in the lower jaw are large with a prominent longitudinal median ridge. These teeth shear mainly with the second pair, the largest of the series in the upper jaw.

Genus BRADYPUS LINNAEUS. Three-toed Sloth

Perhaps the best recognition mark of the genus is the possession of three digits on the fore foot, a character already mentioned in remarks on the family. Two species are known to inhabit Panama.

BRADYPUS GRISEUS GRISEUS (Gray)

Gray Three-toed Sloth

Arctopithecus griseus Gray, Ann. Mag. Nat. Hist., Ser. 4, Vol. 7, p. 302, April, 1871. Type from Cordillera del Chucu, western Panama.

The three-toed sloths of Middle America, as far south as the Canal Zone, are assignable to two fairly well-marked forms: *B. casta-*

neiceps (Gray), from Jabali Gold Mine (2,000 feet) Chontales District, Nicaragua,[1] and the animal described as *B. griseus* (Gray), originally ascribed to Costa Rica, but as shown by Alston (1879, p. 183) really from western Panama. The latter species was placed by Alston (1879, p. 183) in the synonymy of *B. infuscatus* Wagler, of western Brazil, but his identification, evidently based on scant material, seems open to question. It is less distinctly marked with white spots than an Ecuadorean specimen assumed to represent *B. infuscatus,* and along with *B. castaneiceps* lacks the rather conspicuous white spotting which seems to characterize South American species in general. Moreover, it seems to be replaced in eastern Panama by a more spotted species, *B. ignavus.* Until some of the South American forms are better known it seems best to recognize the animal of western Panama as a distinct species.

Specimens from various localities in Costa Rica and as far east as the Canal Zone, are therefore referred to *Bradypus griseus griseus* which seems to differ from *Bradypus griseus castaneiceps*[2] as represented by examples from Escondido River, Nicaragua and Patuca River, Honduras, only in color. *B. g. griseus* lacks most of the chestnut marking the head of *B. g. castaneiceps,* and the ruff across the frontal region is black instead of grayish, or pale brownish. In addition the short fur on the face is whiter and contrasts more strongly with the coarser pelage composing the ruff. An example from Gatun is recorded by Anthony (1916, p. 364).

In the Canal Zone this three-toed sloth and the two-toed species *Choloepus hoffmanni* occur in about equal numbers. Like the latter it was usually found curled up in a ball in the top of a tall tree. The greenish shade, especially of the back, in freshly killed animals is, according to Alston (1879, p. 183), due to small green algæ, also present in *Choloepus.* The misapprehension of the natives in regard to the call of the large goatsucker, or potoo (*Nyctibius*), and their association of its cry with the "perico lijero" seems to apply to both *Bradypus* and *Choloepus* as noted beyond (see p. 60).

Specimens examined: Chorrera, 1[3]; Gatun, 4[3]; Lion Hill, 2.[4]

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[1] For exact locality as here given see letter of Dr. Berthold Seemann to Dr. J. E. Gray (Proc. Zool. Soc. London, 1871, p. 429).

[2] *Arctopithecus castaneiceps* Gray, placed in synonymy by Allen (Bull. Amer. Mus. Nat. Hist., Vol. 28, p. 93, April 30, 1910) should stand as *Bradypus griseus castaneiceps* (Gray) on the basis of color differences pointed out.

[3] One specimen in Amer. Mus. Nat. Hist.

[4] One specimen in Mus. Comp. Zool.

BRADYPUS IGNAVUS Goldman

Panama Three-toed Sloth

[Plate 22, figs. 1, 1*a*]

Bradypus ignavus Goldman, Smiths. Misc. Coll., Vol. 60, No. 22, pp. 1-2, February 28, 1913. Type from Marragantí (about 2 miles above Real de Santa Maria), near the head of tide-water on the Rio Tuyra, eastern Panama.

The three-toed sloth of eastern Panama, apparently a distinct species, is somewhat similar to *B. griseus griseus* of western Panama in color, but the upperparts are more distinctly spotted with white and the frontal ruff is grayish brown instead of black. The skulls of *B. griseus castanciceps* of Nicaragua and *B. g. griseus* seem indistinguishable while that of *B. ignavus* differs from both in apparently important details, the nasals being shorter, with the anterior border concave or emarginate, the emargination deepest at the median suture; the squamosal arm of the zygoma is broader, more rounded, less acutely pointed anteriorly; the palate is less deeply grooved posteriorly; and the mandible is less produced anteriorly beyond the plane of the first molars.

In color pattern as well as cranial details *B. ignavus* differs markedly from *B. g. griseus* and *B. g. castaneiceps* and is more like some of the South American species. It appears to be unlike those described, but its exact relationship to some of the South American members of this unrevised group cannot be determined at present, owing to lack of knowledge of their real characters. While the wide range of variation seen in a series of specimens from a given locality would include many of the characters used as specific by Gray in his diagnoses of various species (1871*a*, pp. 428-449), this variation is shown by examination of Middle American forms to be within definite limits, and when ample material is available the distinctive characters of the species will become better known.

The type specimen was found one day in the extreme top of a very tall tree where it was resting, its body doubled and limbs folded in such a manner that it might easily be mistaken for the nest of a squirrel or some large bird.

Specimens recorded by Anthony (1916, p. 364) from Cituro, Real de Santa Maria and Tapalisa in the region of the type locality are darker, more chocolate brownish in general color, and the light dorsal spots are yellowish instead of nearly pure white as in the type.

Specimens examined: Cituro, 1 [1]; Marragantí, 1 (type)[2]; Real de Santa Maria, 3 [1]; Tapalisa, 1.[1]

[1] Collection Amer. Mus. Nat. Hist.

[2] Two specimens in the U. S. National Museum, from the Atrato River, Colombia, are referable to the same species.

Family CHOLOEPODIDAE. Two-toed Sloths

The two-toed sloths, family Choloepodidae, are similar in habits to the three-toed sloths, family Bradypodidae, but differ notably in details of structure. The number of digits and claws on the fore limbs is reduced to two. The pelage of the top of the head is inclined backward and there is no frontal ruff. The anterior teeth in both jaws are greatly developed, exceedingly sharp, triangular and canine-like, and shearing together exclusively, present a condition very different from that exhibited by the Bradypodidæ. The anterior nares are broad and low. The nasals, laterally expanded between the orbits, articulate with the lachrymals. The audital bullæ are reduced to bony rings. The angle of the mandible is very short and the condyle considerably extended transversely.

Genus CHOLOEPUS Illiger. Two-toed Sloths

The recognition marks of the genus are the same as those of the family.

CHOLOEPUS HOFFMANNI Peters

Hoffmann's Two-toed Sloth; Perico Lijero

Choloepus hoffmanni PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, 1858, p. 128. Type from Costa Rica.

Hoffmann's sloth, originally described from Costa Rica, apparently ranges throughout Panama where it is the only member of the family with the digits and claws of the fore foot reduced to two in number. Specimens from Panama are apparently typical; like those from Costa Rica they exhibit varying intensity of the brownish tone of the underfur. The greenish outer color of the long hairs is now known to be due to the presence of small green algae (Alston, 1879, p. 183), which assist materially in rendering the animal inconspicuous, especially when among masses of epiphytic vegetation.

Under the name *Choloepus didactylus,* Sclater (1856, p. 139) notes the collection of the species by Mr. Bridges in western Panama as follows: "From the vicinity of David. I believe neither this Sloth nor the Little Anteater has been hitherto observed so far north."

These sloths are rather common in the northern end of the Canal Zone where they were usually seen curled up in a ball in the extreme top of some rather tall tree. They commonly choose a fork in which to rest, with their heads upward and the long hooked limbs clasping the main trunk. When shot they often strike out frantically with their long arms, and after a moment slowly loosen their hold and drop crashing to the ground. One was found feeding early in the

afternoon, suspended from a low limb of a tree overhanging the Rio Indio, near Gatun. The animal reached out and with the two-hooked hand drew a small leafy branch to its mouth. Soon noting my canoe, only a few feet distant, the sloth stopped feeding and began to climb slowly away. No specimens were obtained in extreme eastern Panama, but I saw one which had been captured in the forest at 2,000 feet near the Darien gold mines at Cana, and was kept alive for a time by a local resident.

A peculiar prolonged cry occasionally heard in the forest at night was attributed by my men to the *perico lijero,* a name applied in the Canal Zone to both the two-toed and three-toed sloths. When questioned further, however, they were unable to name the species, or ignored the existence of two kinds (*Choloepus* and *Bradypus*) in the same forest. According to Eugène André[1] and other observers this cry, elsewhere believed by natives to be given by a sloth, is in reality the call of the large goatsucker, or potoo (*Nyctibius*). It has a rather weird quality when heard in a tall, partially moonlit forest at such an hour.

Specimens of *C. hoffmanni* collected by W. W. Brown, Jr., at Bugaba and at 4,000 to 4,800 feet near Boquete are listed by Bangs (1902, p. 20). Examples taken for the British Museum by J. H. Batty are recorded by Thomas (1903*a,* p. 42) from Espartal, Sevilla and Cebaco, small islands off the coast of southwestern Panama. The same collector obtained specimens for the American Museum of Natural History, which are noted by Allen (1904, p. 58) as follows: "Five adults and 3 young, as follows, selected from a large series: Parida Island, 1 adult male, Nov. 22; Boquete, 1 adult female, Sept. 14; Boqueron, 1 adult male, 2 adult females, and 3 young, Oct. 13-24, Nov. 22, and Dec. 1.

Mr. Batty's large series of some 50 specimens shows a wide range of individual variation in color, some being much lighter or darker than the average; some have a strong greenish tinge over the whole head and shoulders, while others show no greenish tinge whatever.

Specimens examined: Bocas del Toro, 1; Bugaba, 1[2]; Boqueron, 34[3]; Boquete, 6[4]; Lion Hill, 1; Parida Island, 2[3]; Porto Bello, 1; Rio Indio (near Gatun), 2.

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[1] A Naturalist in the Guianas, 1904, p. 144.

[2] Collection Mus. Comp. Zool.

[3] Collection Amer. Mus. Nat. Hist.

[4] Four in collection Mus. Comp. Zool; two in Amer. Mus. Nat. Hist.

Family MYRMECOPHAGIDAE. Anteaters

The anteaters are the only really toothless American members of the order Edentata. The three well-known South American genera range northward through Panama.

Genus CYCLOPES Gray. Two-toed Anteaters

The genus *Cyclopes* includes very small species at once distinguishable by the reduction of the toes on the fore foot to two, instead of three, as in the other genera of the family. The tapering tail is strongly prehensile, and the general pelage soft and silky.

CYCLOPES DIDACTYLUS DORSALIS (Gray)

Costa Rican Two-toed Anteater

Cyclothurus dorsalis Gray, Proc. Zool. Soc. London, 1865, p. 385, pl. 19. Type from Costa Rica.

The presence of two toes only on the fore foot, and the golden yellowish general coloration and soft silky quality of the pelage of this handsome little anteater readily distinguish it from the other mammals of the region. It is more yellowish, or golden, less grayish in color than typical *C. didactylus,* as originally described and as pointed out by Thomas,[1] who seems fully justified in regarding the Costa Rican animal as a geographic race of the South American species. The animal ranges from Costa Rica into Panama, at least as far east as the Canal Zone where its occurrence was reported by the natives, but I was unable to secure specimens.

The two-toed anteater is more strictly arboreal than the other genera, and owing to this fact, together with its nocturnal habits and small size, easily escapes observation. Of its life history little is known. Bates [2] describes the capture of a living specimen of the allied form in Brazil by an Indian who found it clinging motionless inside a hollow tree. He says: "It remained nearly all the time without motion, except when irritated, in which case it reared itself on its hind legs from the back of a chair to which it clung, and clawed out with its fore paws like a cat. Its manner of clinging with its claws, and the sluggishness of its motions, gave it a great resemblance to a sloth. It uttered no sound and remained all night on the spot where I had placed it in the morning. The next day I put it on a tree in the open air and at night it escaped. These small Tamandúas are nocturnal in their habits, and feed on those species of termites which construct earthy nests that look like ugly excrescences on the

[1] Ann. Mag. Nat. Hist., Ser. 7, Vol. 6, p. 302, September, 1900.

[2] Naturalist on the Amazons, Vol. 1, 1883, p. 178.

trunks and branches of trees." In Costa Rica an example was kept alive for a few days by Dr. A. von Frantzius [1] who says in his account of the animal that it remained motionless during the day, completely rolled up and hanging by its claws from a bar of the cage in which it was confined; but as soon as night came it began to climb slowly about, searching persistently for some avenue of escape. It refused to take any food offered, and as it became noticeably thinner and was abrading its skin in constant efforts to escape from the cage he was reluctantly obliged to kill it. In the same connection Dr. von Frantzius states that this animal, in its habits of climbing, suspending itself by its claws, and rolling the body together, greatly resembles *Cholœpus,* with the superior climbing power afforded by the prehensile tail.

The earliest record of the occurrence of this species in Panama seems to be that of Sclater (1856, p. 139) who as *Cyclothurus didactylus* notes the animal in a collection from Mr. Bridges as follows: "From the vicinity of David. Also seen near Panama. A strictly nocturnal animal."

Under the name *Cycloturus didactylus,* Alston (1879, p. 193) mentions the collection of the species by Enrique Arcé in Chiriqui, but the exact locality is not given. Nine specimens taken by W. W. Brown, Jr., are listed by Bangs (1902, p. 20) from Divala and Bugaba. Measurements of an adult female taken at Boqueron by J. H. Batty are published by Allen (1904, p. 59).

Specimens examined: Bas Obispo, 1 [2]; Boqueron, 1 [3]; Bugaba, 2 [2]; Divala, 7.[2]

Genus TAMANDUAS Gray. Three-toed Anteaters

The anteaters of this genus agree with those of the genus *Myrmecophaga* in the possession of three toes on the fore foot, but differ widely in other respects. The tail is long, tapering and prehensile.

TAMANDUAS TETRADACTYLA CHIRIQUENSIS Allen

Chiriqui Three-toed Anteater

Tamandua tetradactyla chiriquensis ALLEN, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 395, text fig. 4, October 29, 1904. Type from Boqueron, Chiriqui, Panama.

In this species there are three toes on the fore feet as in the great anteater, but the tapering and prehensile instead of bushy tail, and much smaller general size are distinguishing characters.

[1] Archiv. für Naturg., 1869, p. 309.
[2] Collection Mus. Comp. Zool.
[3] Collection Amer. Mus. Nat. Hist.

Although seldom seen these anteaters doubtless range throughout Panama. Specimens from as far east as the Canal Zone and Porto Bello are referred to the form described from western Panama as *Tamandua tetradactyla chiriquensis,* the skulls of which are characterized by the broader, flatter frontal region, longer nasals and correspondingly shorter parietals, as shown by comparison with the Mexican subspecies, *T. t. tenuirostris.* The exact relationship of the Panama animal to "*Myrmecophaga sellata*"[1] Cope from Honduras, however, remains to be determined, the latter being based on an imperfect skin without skull. A skull from Plantain River, Honduras, assumed to represent *T. t. sellata* has a very narrow braincase, but is otherwise somewhat intermediate in general characters between *T. t. tenuirostris* and *T. t. chiriquensis.*

This anteater is partly arboreal, partly terrestrial in habits, while the little two-toed anteater, *Cyclopes,* is strictly arboreal and the great anteater, *Myrmecophaga,* is wholly terrestrial. It comes out to feed, mainly at least, at night; a specimen secured at Porto Bello was killed in the road by a hunter who was carrying an ordinary lantern. He described coming upon the animal suddenly, and how when very near it reared up on its hind feet and struck out with its claws until knocked down by a blow from his gun used as a club. Near Gatun one seen in the forest shortly before dusk one evening was on the ground, but noting my approach clambered rather hastily for five or six feet up the trunk of a tree and disappeared in a hole. At the same locality an example brought in by a native hunter had at least a pound of ants in its stomach. These have been determined by Theo. Pergande of the U. S. Bureau of Entomology and found to represent five genera as follows: *Camponotus atriceps* Smith, *Dolichoderus bispinosus* Mayr, *Pseudomyrma pallida* Smith, *Aphaenogaster* ——— sp.? and *Cremastogaster* ——— sp? Most of the ants were in a larval condition, but some were already winged.

The species is known from various localities in western Panama. Under the name *Uroleptes sellata,* Bangs (1902, p. 20) listed two specimens, one from near the Pacific coast at Divala and the other from 5,000 feet on the slope of the Volcan de Chiriqui. Both were collected by W. W. Brown, Jr., in the course of his field work in the general region. Specimens in the American Museum of Natural History taken by J. H. Batty at Boqueron and Boquete were first

[1] This name, placed by Miller (Bull. 79, U. S. Nat. Mus., 1912, p. 401), in the synonymy of *T. t. tenuirostris,* has priority over the latter and the form seems entitled to stand as *Tamanduas tetradactyla sellata* (Cope).

referred by Allen (1904, p. 59) to *Tamandua tetradactyla* and later in the same year were described by him (1904*b*, p. 395) as a new subspecies. Regarding the distribution of the new form he says: "An adult female from the Rio Cauquita, southwestern Colombia, is exactly like the Boqueron [type locality] specimens in size, coloration and cranial details. A skull, without skin, from near San José, Costa Rica, is also indistinguishable from the adult Boqueron skulls. Apparently *T. t. chiriquensis* will be found to range from Costa Rica to the Cauca region of western Colombia." As *Tamanduas tetradactylus* the species was recorded by Thomas (1903*a*, p. 42) from Gobernador and Cebaco islands, near the coast of southwestern Panama. Anthony (1916, p. 364) listed specimens from Chepigana and Maxon Ranch (Rio Trinidad).

Specimens examined: Boqueron, 3[1]; Boquete, 1[1]; Chepigana, 1[1]; Divala, 1[2]; Gatun, 1; Maxon Ranch (Rio Trinidad), 1[1]; Porto Bello, 1; Volcan de Chiriqui, 1.[2]

Genus MYRMECOPHAGA Linnaeus. Great Anteaters

The anteaters of the genus *Myrmecophaga* are externally easily recognizable by their large size and bushy horse-like tail. As in the genus *Tamanduas* the fore foot is provided with three toes.

MYRMECOPHAGA TRIDACTYLA CENTRALIS Lyon

Central American Great Anteater

Myrmecophaga centralis Lyon, Proc. U. S. Nat. Mus., Vol. 31, p. 570, November 14, 1906. Type from Pacuare, Costa Rica.

Owing to its large size and bushy horse-like tail the great anteater is not likely to be confused with any of the other mammals of the region. Although apparently rare it doubtless ranges in suitable localities throughout Panama. No specimens were obtained, but I examined the skin of an animal said to have been killed in the forest near Gatun. According to a native hunter the great anteater crouches down on the ground and covering itself with the long-haired tail becomes very inconspicuous in the forest cover.

The first published notice of the animal in Panama was by Dampier (1698, p. 60) who found it on the "Sambaloes" or "Samballoes" as the islands in the present Gulf of San Blas were known to English navigators of the latter part of the 17th century. Dampier's quaint account of the great anteater, quoted by Alston (1879, p. 192) seems worth repeating here:

[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Mus. Comp. Zool.

"The Ant-Bear[1] is a four-footed Beast, as big as a pretty large Dog, with rough black-brown Hair: It has short Legs; a long Nose and little Eyes; a very little Mouth, and a slender Tongue like an Earthworm about five or six Inches long. This Creature feeds on Ants; therefore you always find them near an Ants Nest or Path. It takes its Food thus: It lays its Nose down flat on the Ground; close by the Path that the Ants travel in, (whereof here are many in this Country) and then puts out its Tongue athwart the Path: the Ants passing forwards and backwards continually, when they come to the Tongue, make a stop, and in two or three Minutes time it will be covered all over with Ants; which she perceiving, draws in her Tongue and then eats them; and after puts it out again to trapan more. They smell very strong of Ants, and taste much stronger; for I have eaten of them. I have met with these creatures in several places of *America,* as well as here; (*i. e.*, in the *Sambaloes* [Islands in Gulf of San Blas, Panama.]) and in the *South Seas,* on the *Mexican Continent.*" Bates[2] relates how the great anteater, when attacked by a dog, may inflict severe wounds with the powerful claws with which the fore feet are armed.

Alston (1879, p. 192) mentions a specimen received by Messrs. Salvin and Godman from their collector, Enrique Arcé, while working in Veragua. A specimen recorded by Bangs (1902, p. 20) was taken by W. W. Brown, Jr., at Divala, Chiriqui. Comparison of rather scanty material in the principal American museums indicates that the Central American great anteater is closely allied to the South American form.

Specimens examined: Divala, 1[3]; Gatun, 1.

Family DASYPODIDAE. Armadillos

The armadillos, like the sloths, are by no means toothless, as the appellation of the order to which they belong indicates. The bony carapace, or protective armor covering the exposed parts, at once distinguishes them from all other American mammals. Two species representing different genera and subfamilies inhabit the region under consideration.

Subfamily DASYPODINAE. Four-toed Armadillos

The subfamily Dasypodinæ forms a well-marked division with only four toes on the fore foot. The head is narrow, the ears close together, and the snout long and slender. The tail is about as long

[1] Dampier's Voyage, Vol. 2, p. 60, 1698.
[2] Naturalist on the Amazons, Vol. 1, 1863, p. 177.
[3] Collection Mus. Comp. Zool.

as the body, definitely ringed basally, and armored throughout its length.

Genus **DASYPUS** Linnaeus. Four-toed Armadillos

Many separative characters are available for the genus *Dasypus* which in Panama requires comparison only with the genus *Cabassous*. Of the four toes on the front foot the middle pair are subequal in size. The skull as a whole is narrow, with a long, slender, nearly parallel-sided rostrum; the jugal is broadest anteriorly, the outer surface deeply furrowed; the upper tooth series is implanted well in front of the orbital fossæ; the coronoid process of the mandible is long and slender, and rises high over the condyle.

DASYPUS NOVEMCINCTUS FENESTRATUS Peters.

Costa Rican Four-toed Armadillo

Dasypus fenestratus Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, 1864, p. 180. Type from Costa Rica.

The common armadillo, the Linnaean species *Dasypus novemcinctus,* is divisible into several slightly differentiated geographic races, but their number and relationships are not well known. Externally the forms seem so much alike that, allowing for individual variation, there is no readily apparent character by which to separate *D. novemcinctus novemcinctus* of Brazil from the North American subspecies reaching central Texas. The skulls, however, differ in details which are fairly constant and therefore useful in determining the status of the forms. The skull of *D. n. novemcinctus,* as represented by Brazilian specimens, is characterized by the depressed, less inflated frontal region as compared with *D. novemcinctus mexicanus*[1] and *D. novemcinctus texanus;* the jugal and squamosal meet at or behind the highest point of the posterior process on the upper border of the zygoma (meeting in front of this point in *D. n. mexicanus* and *D. n. texanus*) ; the antorbital foramen is shorter; and the palatines extend rather well forward along the median line between the posterior molars. The skulls of *D. novemcinctus texanus,* the most northern form, are usually distinguishable from those of *D. n. mexicanus* by decidedly larger size. The name *D. n. mexicanus,* with which *Tatusia leptorhynchus* Gray is probably synonymous, seems applicable to the form occurring as far south as eastern Honduras.

The skull of a specimen from Gatun, Canal Zone, is very similar to one from Talamanca, Costa Rica, assumed to represent *Dasypus*

[1] Type locality fixed by Bailey as Colima, State of Colima, Mexico (North Amer. Fauna, No. 25, p. 52, Sept. 26, 1901).

fenestratus Peters which was based on an old and a young example from Costa Rica received through Drs. Hoffmann and Von Frantzius. *D. n. fenestratus* seems to be intermediate in cranial characters as well as geographic position between *D. n. mexicanus* and typical *D. n. novemcinctus.* The skull differs from that of *D. n. mexicanus* and approaches that of *D. n. novemcinctus* in the depressed frontal outline, the shorter antorbital foramen, and in the union of the jugal and squamosal near the postorbital process of the zygoma. On the other hand it is nearer *D. n. mexicanus* and departs from the typical form in the tendency toward anterior shortening of the palatines between the last molars, and the laterally swollen condition of the maxillae in front of the lachrymals. Dr. Glover M. Allen[1] has pointed out characters distinguishing the Middle American animal from the typical form, but would unite *D. n. fenestratus* and *D. n. mexicanus* under the former name.

D. n. fenestratus doubtless ranges throughout Panama, and is probably a rather common animal, but owing to nocturnal habits is seldom seen. Specimens have been taken in the western part of the republic. Under the name *Tatu novemcinctus* three specimens collected by J. H. Batty at Boqueron are listed and their measurements given by Allen (1904, p. 60).

Specimens examined: Gatun, 1; Boqueron, 3.[2]

Subfamily CABASSOUINAE. Five-toed Armadillos

The armadillos of the subfamily Cabassouinæ, unlike those of the subfamily Dasypodinæ, are provided with five toes on the fore feet. The head is broad, the ears widely separated and the snout short and broad; the tail is shorter than the body and covered with skin.

Genus CABASSOUS McMurtrie. Five-toed Armadillos

Some of the more important characters of this genus have been given in remarks on the subfamily. The skull differs widely from that of *Dasypus* in general contour as well as in detail. It is short and broad, with a short, stout and rapidly tapering rostrum; the jugal is broadest posteriorly, the outer surface flat; the upper tooth series extends posteriorly well beyond the anterior plane of the orbital fossæ; the coronoid process of the mandible is very short and exceeded in height by the condyle.

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[1] Bull. Mus. Comp. Zool., Vol. 54, pp. 198-199, July, 1911.
[2] Collection Amer. Mus. Nat. Hist.

CABASSOUS CENTRALIS (Miller)

Central American Five-toed Armadillo

Tatoua (*Ziphila*) *centralis* MILLER, Proc. Biol. Soc. Washington, Vol. 13, p. 4, January 31, 1899. Type from Chamelicon, Honduras.

Aside from the differing number of toes on the fore foot, as compared with *Dasypus c. fenestratus* in Panama, the Central American five-toed armadillo is easily recognized by the great size and sickle-like shape of the middle claw.

At Gatun I was shown the bony covering of a *Cabassous* which I took to be of this species. It had been removed from the body and rolled together so that when dry it formed a crude basket. The animal was shot at night near Mindí (between Gatun and Colon) by an American who located it by the light of a hunting lamp. The species is said to be rare in Panama, and few examples have been taken in any part of Middle America. In Costa Rica it is known as "Armado de zopilote" owing to its disagreeable odor, which is likened to that of the black vulture (*Catharista urubu*).

Specimens examined: Gatun, 1.

Order SIRENIA. Sirenians

Family TRICHECHIDAE. Manatees

The manatees are a peculiar group of aquatic mammals inhabiting the delta regions along the Atlantic side of Middle America, northern South America, and western Africa.

Genus TRICHECHUS Linnaeus. Manatees

The genus *Trichechus* includes a manatee which has been reported from the northern coasts of Panama. The manatee is remarkable for the absence of the posterior pair of limbs, the reduction of the anterior pair to paddles, and the transverse expansion of the rudder-like tail.

TRICHECHUS MANATUS Linnaeus

Manatee

Trichechus manatus LINNAEUS, Syst. Nat., ed. 10, Vol. 1, p. 34, 1758. Type from West Indies.[1]

A manatee, doubtfully referable to this species, still inhabits the Chiriqui Lagoon region where it was noted by Dampier (1698, pp. 33-37) on the "coasts of Bocca del Drago" (Boca del Drago) and "Bocco del Toro" (Bocas del Toro). Dr. R. E. B. McKenney,

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[1] Locality fixed by Thomas, Proc. Zool. Soc. London, March, 1911, p. 120.

who has spent several years near Bocas del Toro, informs me that the animal is occasionally reported by native boatmen. The species has probably become scarce here as in many other localities where it was formerly common. I have no record of its occurrence on any other part of the Panama coast. Dampier's general account of the manatee as he observed it from the Bay of Campeche to the "River of Darien" (Rio Atrato) is so interesting that it is quoted at length:

"While we lay here [coast of Nicaragua], our *Moskito* men [Mosquito Indians] went in their Canoa, and struck us some Manatee, or Sea-Cow. Besides this *Blewfields* River, I have seen of the Manatee in the Bay of Campeachy, on the Coasts of *Bocca del Drago* [Panama], and *Bocco del Toro* [Panama], in the River of *Darien,* and among the South Keys or little Islands of *Cuba.* . . . . This creature is about the bigness of a Horse, and 10 or 12 foot long. The mouth of it is much like the mouth of a Cow, having great thick Lips. The Eyes are no bigger than a small Pea, the Ears are only two small holes on each side of the Head. The Neck is short and thick, bigger than the Head. The biggest part of this Creature is at the Shoulders, where it hath two large Fins, one on each side of its Belly. Under each of these Fins the Female hath a small Dug to suckle her young. From the Shoulders towards the Tail it retains its bigness for about a foot, then groweth smaller and smaller to the very Tail, which is flat and about 14 inches broad, and 20 inches long, and in the middle 4 or 5 inches thick, but about the edges of it not above 2 inches thick. From the Head to the Tail it is round and smooth without any Fin but those two before mentioned. I have heard that some have weighed about 1200 l. but I never saw any so large. The Manatee delights to live in brackish water; and they are commonly in Creeks and Rivers near the Sea. . . . . Sometimes we find them in salt Water, sometimes in fresh; but never far at Sea. And those that live in the Sea at such places where there is no River nor Creek fit for them to enter, yet do commonly come once or twice in 24 hours to the mouth of any fresh water River that is near their place of abode. They live on Grass 7 or 8 inches long, and of a narrow blade, which grows in the sea in many places, especially among Islands near the Main. This Grass groweth likewise in Creeks or in the great Rivers, near the sides of them, in such places where there is but little tide or current. They never come ashore, nor into shallower water than where they can swim. Their flesh is white, both the fat and the lean, and extraordinary sweet wholesome meat. The tail of a young Cow is most esteemed; but if old both head and tail are very

tough. A Calf that sucks is the most delicate meat; Privateers commonly roast them; as they do also great pieces cut out of the Bellies of the old ones.

"The Skin of the Manatee is of great use to Privateers, for they cut them into straps, which they make fast on the sides of their Canoas through which they put their Oars in rowing, instead of tholes or pegs. The Skin of the Bull, or of the back of the Cow is too thick for this use; but of it they make Horse-whips, cutting them 2 or 3 foot long: at the handle they leave the full substance of the Skin, and from thence cut it away tapering, but very even and square all the four sides. While the Thongs are green they twist them, and hang them to dry: which in a weeks time becomes as hard as Wood. The *Moskito*-men have always a small Canoa for their use to strike Fish, Tortoise, or Manatee, which they keep usually to themselves, and very neat and clean. . . . . One of the *Moskitoes* (for there go but two in a Canoa) sits in the stern, the other kneels down in the head, and both paddle till they come to the place where they expect their game. Then they lie still or paddle very softly, looking well about them, and he that is in the head of the Canoa lays down his paddle, and stands up with his striking staff in his hand. This staff is about 8 foot long, almost as big as a mans Arm, at the great end, in which there is a hole to place his Harpoon in. At the other end of his staff there is a piece of light wood called Bobwood, with a hole in it, through which the small end of the staff comes; and on this piece of Bobwood, there is a line of 10 to 12 fathom wound neatly about, and the end of the line made fast to it. The other end of the line is made fast to the Harpoon, which is at the great end of the Staff, and the *Moskito* man keeps about a fathom of it loose in his hand. When he strikes, the Harpoon presently comes out of the staff, and as the Manatee swims away, the line runs off from the bob; and although at first both staff and bob may be carried under water, yet as the line runs off it will rise again. Then the *Moskito* men paddle with all their might to get hold of the bob again, and spend usually a quarter of an hour before they get it. When the Manatee begins to be tired it lieth still, and then the *Moskito* men paddle to the bob and take it up, and begin to hale in the line. When the Manatee feels them he swims away again, with the Canoa after him; then he that steers must be nimble to turn the head of the Canoa, and holding the line, both sees and feels which way the Manatee is swimming. Thus the Canoa is towed with a violent motion, till the Manatee's strength decays. Then they gather in the line, which they are often forced to let all go

to the very end. At length when the creatures strength is spent, they hale it up to the Canoas side, and knock it on the head and tow it to the nearest shore, where they make it fast, and seek for another; which having taken they go on shore with it, to put it into their Canoa: for 'tis so heavy that they cannot lift it, but they hale it up in shoal water, as near the shore as they can, and then overset the Canoa, laying one side close to the Manatee. Then they roll it in, which brings the Canoa upright again, and when they have heav'd out the water, they fasten a line to the other Manatee that lieth afloat, and tow it after them. I have known two *Moskito* men for a week every day bring aboard 2 Manatee in this manner; the least of which hath not weighed less than 600 pound, and that in a very small Canoa, that 3 *English* men would scarce adventure to go in. When they strike a cow that hath a young one, they seldom miss the Calf, for she commonly takes her young under one of her Fins. But if the Calf is so big that she cannot carry it, or so frightened that she only minds to save her own life, yet the young never leaves her till the *Moskito* men have an opportunity to strike her.

"The manner of striking Manatee and Tortoise is much the same; only when they seek for Manatee they paddle so gently, that they make no noise, and never touch the side of the Canoa with their paddle; because it is a Creature that hears very well. But they are not nice when they seek for tortoise, whose Eyes are better than his Ears."

The manatee was also recorded from near the eastern boundary of Panama by Maack (1874, p. 171) who says: "The manati is frequently caught by the natives in the Atrato and in the Cacarica. Its meat is highly prized by the natives, and I had the pleasure, during my stay at the Cacarica hills, to partake with some caoutcheros [rubber gatherers] of such a Manati dinner."

Order ARTIODACTYLA. Artiodactyls or Even-toed Ungulates

Family TAYASSUIDAE. Peccaries

The family Tayassuidae includes two genera of peccaries, or pig-like species fairly well known in the region under review. Both have extremely short tails. Large glands opening upon the back give off a peculiar rank odor by which the proximity of a herd to windward may often be detected long before the animals can be heard or seen.

Genus PECARI Reichenbach. Collared Peccaries

The collared peccaries are smaller, more grizzled in color, than the white-lipped peccaries of the genus *Tayassu*. They are also recognizable by the light shoulder stripes forming the so-called "collar." Generic distinction is, however, better shown in the skull: The rostrum is much narrower, more highly arched along the median line above; the maxillæ are not laterally expanded over the first molars; the palate has a distinct ridge extending from the canine to the anterior premolar; the molar teeth have rather more-developed cingula, and the cusps are less closely connected by intermediate cusplets.

PECARI ANGULATUS CRUSNIGRUM (Bangs)

Chiriqui Collared Peccary

Tayassu crusnigrum Bangs, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 20, April, 1902. Type from Boquete, Chiriqui, Panama (altitude 4,000 feet).

The collared peccary of western Panama and adjacent portions of Costa Rica is a remarkably dark, richly colored animal with tawny instead of whitish shoulder stripes, or "collar," usual in the group.

The original description was based on specimens collected by W. W. Brown, Jr. Mr. Bangs described it as a distinct species "because the relationship of the North American forms and the South American *T. tajacu* [*Pecari tajacu*] are not as yet clearly understood."

The exact relationship to South American species still remains to be determined, but examination of specimens from numerous localities indicates that all of the collared peccaries of Middle America may be regarded as subspecies of *Pecari angulatus*. Specimens from Honduras are intermediate in color and in cranial details also indicate intergradation between the present dark form and the pallid subspecies, *P. a. yucatanensis,* which inhabits the peninsula of Yucatan.

The range of *P. a. crusnigrum* is little known. It includes the highlands of the western part of the republic, and lowlands of eastern Costa Rica. In the Canal Zone and eastward it is replaced by the paler form, *P. a. bangsi.*

Specimens examined: Boquete, 3.[1]

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[1] Collection Mus. Comp. Zool.

PECARI ANGULATUS BANGSI Goldman

Bangs Collared Peccary; Zajino

Pecari angulatus bangsi GOLDMAN, Proc. Biol. Soc. Washington, Vol. 30, p. 109, May 23, 1917. Type from Boca de Cupe, eastern Panama (altitude 250 feet).

In paler coloration the collared peccary of eastern Panama differs markedly in appearance from the darker, richer-hued animal inhabiting western Panama.

As "zajino" it is well known to the natives of the Canal Zone and doubtless ranges in the forests throughout the eastern part of the republic. Although occurring in much smaller herds than the white-lipped peccary it is more frequently met with and seems to exceed that species in numbers. Parties of five or six to twelve or fifteen individuals are not uncommonly met with, and lack of time to devote to the species alone prevented me from securing a large series of specimens.

A few small tracks and the depressions left where these peccaries have been rooting or wallowing in mud may often be seen in isolated parts of the forest. Fresh peccary work was seen nearly every day not far from camp in the forest at about 800 feet on the basal slope of Cerro Azul, but I did not see any of the animals, probably owing to their becoming alarmed at shots frequently fired at other game.

The earliest account of this peccary in Panama, and the Indian method of hunting it, is that of Lionel Wafer (1729, p. 328) whose observations, made in 1681, are quoted as follows:

"The Country has of its own a kind of Hog, which is called *Pecary,* not much unlike a Virginia Hog. 'Tis black, and has little short Legs, yet is pretty nimble. It has one thing very strange, that the Navel is not upon the Belly, but the Back: And what is more still, if upon killing a *Pecary* the Navel be not cut away from the Carcass within 3 or 4 hours after at farthest, 'twill so taint all the flesh, as not only to render it unfit to be eaten, but make it stink insufferably. Else 'twill keep fresh several days, and is very good wholesome Meat, nourishing and well tasted. The *Indians barbecue* it when they keep any of it longer. . . . . These Creatures usually herd together, and range about in Droves; and the Indians either hunt them down with their Dogs, and so strike them with their Lances, or else shoot them with their Arrows, as they have Opportunity."

Wafer evidently mistook the dorsal gland for the navel. As stated by him the part is removed as soon as possible after an animal is killed, and should not be allowed to touch meat intended for food.

Collared peccaries are still hunted with dogs; they are smaller, more easily overtaken, and are not regarded as so dangerous either to the dogs or hunters as the white-lipped peccary.

Alston (1879, p. 107) recorded the species from Panama as living in the gardens of the Zoological Society of London.

Specimens now recognized as *P. a. bangsi* from Gatun and Real de Santa Maria were assigned by Anthony (1916, p. 364) to *Pecari crusnigrum.*

Specimens examined: Boca de Cupe, 1; Escobal (Gatun Lake), 1 [1]; Gatun, 5 [2]; Real de Santa Maria, 2.[1]

Genus TAYASSU Fischer. White-lipped Peccaries

The white-lipped peccaries are larger and blacker than the collared peccaries of the genus *Pecari,* and are further distinguished externally by conspicuous white areas extending from the mouth along the sides of the face. The skull of *Tayassu,* contrasted with that of *Pecari,* differs notably as follows: The rostrum is broadly flattened above (not narrow and highly arched along the median line); the maxillae are greatly expanded laterally over the first premolars; the palate lacks the distinct marginal ridge extending in *Pecari* from the canine to the anterior premolar; the molar cusps are more closely connected by intermediate cusplets.

TAYASSU PECARI SPIRADENS Goldman

Costa Rican White-lipped Peccary; Puerco de Monte

Tayassu albirostris spiradens Goldman, Proc. Biol. Soc. Washington, Vol. 25, p. 189, December 24, 1912. Type from Talamanca, Costa Rica. (Probably near Sipurio, in the valley of the Rio Sicsola.)

The Costa Rican white-lipped peccary inhabits Costa Rica and adjoining territory; and is doubtless generally distributed in the forests of the greater part of Panama. It is one of the few mammals known to occur in the region but of which no specimens are as yet available for examination. Eight skulls in the Museum of Comparative Zoölogy collected by G. A. Maack on the Isthmus of Panama are referable to this form, but the indefinite locality may apply to what is now Colombian territory. In the vicinity of the Canal Zone, where it is known to the natives as "puerco de monte," the white-lipped peccary occurs in much smaller numbers than the collared species. Unlike the latter animal it gathers in herds which may number 100 or more individuals. These herds move steadily about,

[1] Collection Amer. Mus. Nat. Hist.

[2] Three specimens in collection Amer. Mus. Nat. Hist.

usually through parts of the forest remote from civilization. The "puerco de monte" is regarded by the natives here, as elsewhere in Middle America, as more dangerous than the "zahino" or collared peccary, which besides being much smaller, travels in fewer numbers. According to report a herd of white-lipped peccaries may, if unmolested, pass very near and apparently pay no attention to hunters; but if one is wounded or attacked by dogs the entire herd may gather and force the hunters to climb trees. Dogs are said to be not infrequently killed by them.

On Cerro Azul several broad, conspicuous trails left by moving herds of white-lipped peccaries were seen at about 1,500 feet altitude. These trails made by the single passage of a herd were marked by many tracks, freshly mutilated, low growing vegetation, and spots where the animals had stopped to root in the soft soil. Similar trails were noted at about 5,000 feet altitude on the upper slopes of the Pirre Mountains. On one occasion I was near enough to detect the strong characteristic odor of these animals, but when I reached their trail it was nearly dark and I was obliged to return to camp. On the following morning, accompanied by one of my Colombian packers, I followed the trail with difficulty for some distance; it led through densely matted vegetation along a rugged shoulder of the mountain and we were finally obliged to turn back. According to my men the peccaries nearly always skirt a mountain, traveling across the slope rather than choosing a route directly over the top.

Anthony (1916, p. 365) reports encountering a small band supposed to be of this species at 5,000 feet in the vicinity of Mount Tacarcuna, but no specimens were secured by him.

The quaint accounts by Lionel Wafer (1729, pp. 328, 368) apply in part to this species which he calls "warree" and in part to the collared peccary. Referring to the hunting of peccaries by the Indians of eastern Panama, he says:

"The *Warree* is another kind of Wild-Hog they have, which is also very good Meat. It has little Ears, but very great Tusks; and the Hair or Bristles 'tis covered with are long, strong and thickset, like a coarse Furr all over its Body. The *Warree* is fierce, and fights with the Pecary, or any other Creature that comes his way. The *Indians* hunt these also as the other, and manage their Flesh the same way, except only as to what concerns the Navel; the Singularity of which is peculiar to the *Pecary*.

"Their chief Game are the *Pecary* and *Warree;* neither of which are swift of Foot. They go in Droves, often 2 or 300; so that if the *Indians* come upon them unawares, they usually kill some by random

Shot among them. But else, they are many times a whole Day without getting any; or so few, considering how many they start, that it seems a great toil to little Purpose. I have seen about a thousand started, in several Droves, when I was hunting with them; of which we killed but two, as I remember. Sometimes when they are shot, they carry away the Arrows quite. When the Beast is tired, it will stand at a Bay with the Dogs; which will set him round, lying close, not daring to seize, but snapping at the Buttocks; and when they see their Master behind a Tree ready to shoot, they all withdraw to avoid the Arrow. As soon as an *Indian* hath shot a Pecary or Warree, he runs in and lances them; then he unbowels them, throwing away the Guts, and cuts them in two across the Middle. Then he cuts a piece of Wood sharp at both ends; sticks the Forepart of the Beast at one End, and the Hinder-part at the other. So each laying his Stick across his Shoulder, they go to the Rendezvous, where they appointed the Women to be; after which they carry their Meat Home, first barbecuing it that Night."

In connection with his description of the collared species Bangs (1902, p. 21) says: "A white-lipped peccary also occurs in Chiriqui. Mr. Brown [W. W. Brown, Jr.] saw them several times, but those wounded escaped in the dense jungle."

Family CERVIDAE. Deer

The family Cervidæ is composed of several existing subfamilies of deer-like animals of which one, the Cervinæ, ranges in Panama.

Subfamily CERVINAE. Deer

The subfamily, as represented in the region under review, includes the genus *Odocoileus* to which the familiar Virginia deer belongs, and the genus *Mazama* which is restricted to South and Middle America.

Genus ODOCOILEUS Rafinesque

The genus *Odocoileus* is externally distinguished from the genus *Mazama* by larger general size, and the possession of well-developed branching antlers.

ODOCOILEUS CHIRIQUENSIS Allen

Chiriqui White-tailed Deer; Venado

Odocoileus rothschildi chiriquensis Allen, Bull. Amer. Mus. Nat. Hist., Vol. 28, p. 95, April 30, 1910. Type from Boqueron, Chiriqui, Panama.

The Chiriqui white-tailed deer may be known by its larger size and branching antlers as compared with the forest deer or brocket;

it also differs from that animal in local habitat. It appears to be restricted in Panama mainly to the partly open savanna region between the coast and the mountains on the Pacific side from the Costa Rican frontier eastward to the Bayano River. It also inhabits savannas in the Chagres Valley east of the Canal Zone and is common in partly cleared spaces all along the Canal route, apparently having followed the old line of the Panama Railroad northward to the vicinity of Colon. The white-tailed deer favors the forest borders or the dense thickets and mixed growth of small trees and shrubby vegetation which springs up wherever the original forest is cut, while the brocket, more retiring in habits, prefers the depths of the forest. It is apparently absent in the unbroken forests of the eastern and northern parts of the republic, regions regularly inhabited by the brocket.

Few specimens have been collected and the exact relationship of the Panama forms to *Odocoileus costaricensis* remains to be determined. Specimens from as far east as the Canal Zone are referred to *Odocoileus chiriquensis*. This deer was described by Allen (*l. c.*) as a subspecies of the insular form, *O. rothschildi*, on the basis of specimens which had previously been assigned by him (1904, p. 63) to *O. costaricensis*. The Chiriqui animal is characterized by him as larger and paler and the young less conspicuously spotted than *O. rothschildi*.

The type of *O. chiriquensis* is a young female with the deciduous premolars still in place and the posterior molar rising from the alveolus. A female topotype has acquired a full series of permanent molariform teeth, but they are very slightly worn. The other topotype material consists mainly of separate horns. As noted by Allen (1910, p. 95) it is somewhat paler than *O. rothschildi*, but the decidedly larger size is a better differential character. It is probably more nearly allied to *O. costaricensis* with which it was first associated, but the latter was founded on a young male; in the absence of properly comparable material the relationship to that form cannot be determined and it seems best to treat it as a distinct species.

During the construction of the Panama Canal white-tailed deer were regularly hunted by organized clubs of white employees using hounds to drive them from cover; and yet the deer remained fairly numerous near points where heavy blasting and other noisy operations were conducted on a large scale.

A freshly killed female specimen from near Corozal was received through the Sanitary Inspector, A. R. Proctor, January 22, 1911. Giving a sharp snort she sprang out before the hounds on the brush-

covered slope of a hill. She circled about several times and was finally shot. Her condition showed that she was nursing a fawn, but the latter was not seen. The date indicates earlier, or possibly more irregular, breeding habits than are usual in northern deer.

Sir Victor Brooke (1878, p. 919) recorded specimens of white-tailed deer as collected in Panama by Mr. Salvin, but mentioned no exact locality. The specimens may have been taken by Enrique Arcé, a collector who was employed by Salvin for several years in Veragua and Chiriqui. Brooke is quoted and the same material cited by Alston (1879, p. 115). Bangs (1902, p. 21) records the collection of a young white-tailed deer by W. W. Brown, Jr., at 4,000 feet near Boquete, April 10, 1900, concerning which he says: "This specimen is in the spotted pelage, and is too young to identify. The species was rare, but was well known to the native hunters."

Specimens examined: Boqueron, 9[1]; Boquete, 1[2]; Corozal, 1; Gatun, 3.

ODOCOILEUS ROTHSCHILDI (Thomas)

Rothschild's White-tailed Deer

Dama rothschildi THOMAS, Novitates Zoologicæ, Vol. 9, p. 136, April 10, 1902. Type from Coiba Island, off west coast of Panama.

Rothschild's white-tailed deer is known only from Coiba Island. It was originally described as "Size very small, about the smallest of the genus; general colour above brown tipped with fawn." Allen (1904, p. 60) having obtained topotypes from J. H. Batty compared them with specimens from the mainland which he regarded as representative of *Odocoileus costaricensis* Miller, and later (1910, p. 95) named *Odocoileus rothschildi chiriquensis*. Writing in 1904 he says: "The three males, though adult, vary greatly in size and in the development of the antlers, and show that Mr. Thomas's two specimens on which he based the species were young or undersized adults. As regards the external characters there is little to add to Mr. Thomas's description, except that the upper surface of the tail in most of these examples is dark reddish brown above instead of 'fawn.' The ears in most of the specimens are externally nearly naked." He (1904, p. 63) further states: "*O. rothschildi* is much darker colored when adult than *O. costaricensis,* and the young are less conspicuously spotted with white; it is also much smaller, as stated by Mr. Thomas."

While darker in color as indicated by Thomas (*l. c.*) and Allen (1910, p. 95) the much smaller general size more readily distin-

[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Mus. Comp. Zool.

guishes *O. rothschildi* from *O. chiriquensis* of the adjacent mainland. Skulls of the two forms, of comparable age and sex, exhibit close conformity in most characters, but the disparity in size and apparent absence of any trace of intergradation seems to warrant the use of a specific name for the island animal.

Specimens examined: Coiba Island, 3.[1]

Genus MAZAMA Rafinesque. Brockets or Forest Deer

The forest deer of the genus *Mazama* are small species with antlers reduced to simple spikes not exceeding half the length of the head. The body is heavy for so small an animal, but the limbs are very slender. The metatarsal gland, usually present in *Odocoileus*, is absent in this genus.

MAZAMA SARTORII REPERTICIA Goldman

Canal Zone Forest Deer; Cabra de Monte

Mazama tema reperticia GOLDMAN, Smiths. Misc. Coll., Vol. 60, No. 22, p. 2, February 28, 1913. Type from Gatun, Canal Zone, Panama.

The little forest deer, or brocket, known to natives of the Canal Zone and to Costa Ricans as "cabra de monte," is a smaller animal than the white-tailed deer and the antlers of the male are short unbranched spikes as pointed out in the remarks on the genus. The ears are short and rounded. The tail is white on the under side as in the so-called white-tailed deer, but is not conspicuously shown as in that animal when running away. Unlike the white-tailed deer, which favors the forest borders, or partially cleared areas, the brocket prefers thickets in remote parts of the forest. The small tracks were seen in various places and the Canal Zone subspecies is assumed to be the rather common form inhabiting the unbroken forests, especially of the eastern and northern parts of the republic, but owing to extreme shyness is seldom seen and few examples are available for study. *M. s. reperticia* differs from *M. s. sartorii* of Mexico in somewhat larger size and in duller much less rufescent coloration. A richer reddish colored form, *M. s. cerasina* Hollister, recently described from Talamanca, Costa Rica, may replace *M. s. reperticia* in parts of western Panama. In the Middle American brockets the orbital areas and much of the face is rusty reddish; in *Mazama bricenii* Thomas and other South American species, aside from other differential characters, the face including the orbital areas is very dark brown or blackish.

[1] Collection Amer. Mus. Nat. Hist.

Very few of these small deer were killed in the Canal Zone by the white employees engaged in the construction of the Panama Canal who hunted regularly in well-organized parties using hounds to drive game from cover; the white-tailed deer, on the contrary, were easily obtained often in the immediate vicinity of noisy construction camps.

The early account of deer in eastern Panama by Lionel Wafer (1729, p. 329) seems to apply to this species. Referring to game hunted by the Indians of the region, he says:

" They have considerable Store of *Deer* also, resembling most our *Red Deer;* but these they never hunt nor kill; nor will they ever eat of their Flesh, though 'tis very good; but we were not shy of it. Whether it be out of Superstition, or for any other reason that they forbear them, I know not: But when they saw some of our Men killing and eating of them, they not only refused to eat with them, but seemed displeased with them for it. Yet they preserve the Horns of these Deer, setting them up in their Houses; but they are such only as they shed, for I never saw among them so much as the Skin or Head of any of them that might shew they had been killed by the *Indians;* and they are too nimble for the Warree, if not a Match for him."

Under the name *Mazama sartorii,* Bangs (1902, p. 21) published measurements of three adults collected by W. W. Brown, Jr., at 4,000 to 4,800 feet near Boquete on the southern slope of the Volcan de Chiriqui. In his revision of the genus, Allen (1915*a*, p. 543) records specimens collected by W. B. Richardson at Chepigana, Real de Santa Maria, Tapalisa, Boca de Cupe and Cituro. These records are republished by Anthony (1916, p. 365) with the addition of Maxon Ranch (Rio Trinidad).

Specimens examined: Boca de Cupe, 1[1]; Bocas del Toro, 1; Boquete, 3[2]; Cana, 1; Chepigana, 1[1]; Cituro, 1[1]; Gatun (type locality), 2; Maxon Ranch (Rio Trinidad), 1[1]; Real de Santa Maria, 4[1]; Tapalisa, 3.[1]

Order PERISSODACTYLA. Perissodactyls or Odd-toed Ungulates

Family TAPIRIDAE. Tapirs

The tapirs, the largest indigenous land mammals of Panama, are the only existing American odd-toed ungulates. The single genus *Tapirella* is known from the region; the genus *Tapirus* has not been reported, but may possibly occur.

[1] Collection Amer. Mus. Nat. Hist.

[2] Collection Mus. Comp. Zool.

Genus TAPIRELLA Palmer. Tapirs

The genus *Tapirella* ranges in the tropical parts of Middle America from eastern Panama northward to southern Mexico. Generic distinction is found in the differing arrangement of the bony parts supporting the proboscis, as compared with the other genera of the family. The nasals are flat, triangular bones without the stout descending processes which in *Tapirus* of South America meet and overlap the maxillæ; the maxillæ are developed upward in thin vertical plates which embrace an anterior ossified extension of the mesethmoid, absent in Tapirus and in the Asiatic member of the group, *Acrocodia*.

TAPIRELLA BAIRDII (Gill)

Baird's Tapir; Danta

Elasmognathus bairdii Gill, Proc. Acad. Nat. Sci., Philadelphia, 1865, p. 183. Type from Isthmus of Panama.

Baird's tapir is still a rather common animal in the forests of the Canal Zone and of the republic in general; and it ranges from sea level to at least 5,000 feet altitude on the mountains. The species was described from the "Isthmus of Panama" and specimens from the Canal Zone are, therefore, typical.

Dampier's (1698, Vol. 2, p. 102) early account of the habits of the animal, which he never saw himself, seems to refer in part to Baird's tapir in Panama. He says: "This Creature is always found in the Woods near some large River; and feeds on a sort of long thin Grass, or Moss, which grows plentifully on the Banks of Rivers; but never feeds in Savannahs, or Pastures of good Grass, as all other Bullocks do. When her Belly is full, she lies down to sleep by the Brink of the River; and at the least Noise slips into the Water; where sinking down to the Bottom, tho' very deep, she walks as on dry Ground. She cannot run fast, therefore never rambles far from the River; for there she always takes Sanctuary, in case of danger. There is no shooting of her but when she is asleep. They are found, besides this place [Campeche], in the Rivers in the Bay of Honduras; and on all the Main from thence as high as the River of *Darien*. Several of my Consorts have kill'd them there, and knew their Track, which I myself saw in the *Isthmus of Darien;* but should not have known it, but as I was told by them. For I never did see one, nor the Track of any but once."

The occurrence of the tapir in the Canal Zone was noted by Maack (1874, p. 171) who records it as living especially in the lowlands

between Gatun and Bas Obispo. Alston (1879, p. 103) quotes Captain Dow as authority for the statement that the favorite haunts of Baird's tapir "appear to be in the hills lying at the back of Lion Hill and the adjoining stations of the Panama Railway. It is only during the rainy season that they seem to seek the lowlands; for it is only at that season that they are captured. They are not hunted by the natives; and it is only when they happen to stray out into the open spaces of the railway that the young ones are sometimes captured alive and the old ones shot." The species remained common in the locality mentioned by Dow until by the recent completion of the Gatun Dam much of the area has been submerged. During the construction of the Panama Canal I was surprised to find tapirs inhabiting the forested areas immediately along the canal route where they seemed to be comparatively unmindful of the heavy blasting and constant movement of men and material. They frequently visited the Mount Hope Reservoir near Colon and the Agua Clara Reservoir near Gatun, apparently enjoying the immunity from molestation afforded by the enforced regulations prohibiting trespassing by the general public on neighboring watersheds.

On the Pirre range in extreme eastern Panama trails made in the forest and regularly used by tapirs were seen at various elevations on steep slopes, and along the tops of the highest ridges. These well-beaten routes were filled with the characteristic tracks of the animals deeply impressed in the muddy ground. Viewed from a short distance they resemble cattle trails. As the trails here show, the rather clumsy looking tapir is able to climb up and down precipitous places; but in the bottom of a narrow gorge I came upon the body of one that had evidently been killed by a fall from the hillside above. Climbing up and examining the slope I was able to locate the exact spot where in attempting to pass across the face of a steep bank, the loose wet soil and leaves covering the underlying clay had slipped from beneath its feet, and in spite of some struggles to regain its balance the tapir had tumbled about 200 feet. Decomposition of the body was well advanced, but there were no indications that carnivorous animals larger than beetles and larval flies had fed upon the flesh.

These tapirs are very shy and seldom venture outside of the denser forest cover. When frightened or pursued by dogs they rush violently through tangled thickets, breaking down vines and other vegetation barring the way. At low elevations near San Miguel Bay I saw places where the tapirs had wallowed in muddy pools in the forest. Tapirs have occasionally been killed in the Canal Zone by

hunting clubs using hounds. A fine male specimen obtained through the Gatun Hunting Club was shot one morning near the shore of Gatun Lake by a member who was stationed only about 100 yards from me—so near that I heard the animal tearing its way through the undergrowth before the baying hounds, and heard its heavy fall following the report of my companion's rifle. Like all of the larger terrestrial mammals inhabiting the forests of the region this tapir was infested with ticks, which become troublesome when numbers begin crawling up one's arms; they take advantage of every contact with the animal during the skinning process and transportation of the skin to affix themselves to one's body. The tapirs often escape the hounds by entering the water. As Captain Dow has indicated they are seldom hunted by natives of the Canal Zone, but when killed by foreigners the flesh is sometimes eaten by certain classes of the native population.

The species is known to reach about the same altitude on the mountains of western, as of eastern Panama. Bangs (1902, p. 22) records the collection of a fine old male adult by W. W. Brown, Jr., at 5,000 feet, near Boquete on the southern slope of the Volcan de Chiriqui. Anthony (1916, p. 365) mentions noting frequently the tracks of this species in the Canal Zone and on the slopes of Mount Tacarcuna.

While no specimens of the South American tapir, *Tapirus terrestris,* are known from Panama, a skull of this species in the U. S. National Museum is labeled as collected by William M. Gabb in Talamanca, Costa Rica, along with a number of skulls of *Tapirella bairdii* from the same locality. There seems to be nothing irregular about the record of this skull, but occurrence of the species so far north lacks confirmation.

Specimens examined: Boquete, 1[1]; Cana, 2; Gatun, 2; Mount Hope (near Colon), 1; Mount Pirre, 1.

Order RODENTIA. Rodents

Family MURIDAE

Rats, Mice

The family Muridæ includes a large number of species of rat-like animals, many of which are much alike in general external appearance, their differential characters becoming fully apparent only when the skulls and teeth are examined.

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[1] Collection Mus. Comp. Zool.

Subfamily CRICETINAE. Harvest Mice, Rice Rats, Cotton Rats, etc.

Genus REITHRODONTOMYS Giglioli

The harvest mice are among the smallest of the Muridæ. They are slender, long-tailed animals resembling very closely some of the smaller species of *Oryzomys,* but easily distinguished by the distinct longitudinal grooves in the upper incisors.

Subgenus REITHRODONTOMYS Giglioli.

REITHRODONTOMYS AUSTRALIS AUSTRALIS Allen

Irazu Harvest Mouse

Reithrodontomys australis ALLEN, Bull. Amer. Mus. Nat. Hist., Vol. 7, p. 328, November 8, 1895. Type from Volcan de Irazu, Costa Rica.

Reithrodontomys australis vulcanius BANGS, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 38, text figs. 16-17, April, 1902. Type from Volcan de Chiriqui, Chiriqui, Panama (altitude 10,300 feet).

The Irazu harvest mouse ranges from Costa Rica into western Panama. Two specimens collected by W. W. Brown, Jr., at 4,000 feet, near Boquete on the southern slope of the Volcan de Chiriqui have been noted by Bangs (1902, p. 37) who says: "These I have compared with the type of *R. australis* from Volcan de Irazu, Costa Rica, loaned by Dr. Allen. In color they exactly agree, except that the upper surface of the feet is darker, more grayish—the feet being whitish in the type. The skulls of the two Boquete specimens are heavier throughout, especially the rostral part, and in this character they are intermediate between true *R. australis* and the form described below from the summit of the Volcan de Chiriqui." *R. a. vulcanius,* the form referred to by Bangs, has been regarded by Howell (1914, p. 62) as agreeing too closely for separation from typical *R. a. australis.* Specimens from Boquete and from near the summit of the volcano appear very different as indicated by Bangs, but the differences are scarcely beyond the range of individual variation exhibited by a series of typical examples of *R. a. australis.* Additional specimens from Panama are much needed in order to determine the point satisfactorily. If the two forms are inseparable *R. a. australis* has an altitudinal range of over 6,000 feet on the slope of the Volcan de Chiriqui.

R. a. australis belongs to the typical subgenus, *Reithrodontomys,* which lacks the mesostyles and mesostylids present in the subgenus *Aporodon,* the group including the other known forms of the region.

Specimens examined: Boquete, 2.[1]

[1] Collection Mus. Comp. Zool.

Subgenus APORODON Howell

REITHRODONTOMYS CREPER Bangs

Chiriqui Harvest Mouse

Reithrodontomys creper Bangs, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 39, April, 1902; text figs. 18-19. Type from Volcan de Chiriqui, Chiriqui, Panama (altitude 11,000 feet).

The Chiriqui harvest mouse is known only from the single example collected by W. W. Brown, Jr., on the cold, barren summit of the Volcan de Chiriqui.

It is a dark brownish species, darker in general color than *Reithrodontomys australis australis* which inhabits the same mountain and reaches nearly the same elevation. It differs widely from its congener in cranial characters and belongs to another section of the genus, one in which the outer wall of the antorbital foramen is narrower and the dentition more complicated by small accessory tubercles than in the more typical forms. This group with more complicated dentition has recently been set apart by Howell (1914, p. 63), as the subgenus *Aporodon*, to which all of the South American species belong.

Specimens examined: Volcan de Chiriqui, 1 (type).[1]

REITHRODONTOMYS MEXICANUS CHERRII (Allen)

Cherrie's Harvest Mouse

Hesperomys (*Vesperimus*) *cherrii* Allen, Bull. Amer. Mus. Nat. Hist., Vol. 3, p. 211, April 17, 1891. Type from San José, Costa Rica.

The range of Cherrie's harvest mouse closely parallels that of *Reithrodontomys australis australis* from Costa Rica into western Panama where, on the lower slopes of the Volcan de Chiriqui, the two apparently occur at the same locality. *R. m. cherriei* is a larger form than *R. a. australis,* with a tail measuring over 100 millimeters, while in the latter animal the length of the member is usually less than 90 millimeters. Moreover, they belong to different subgenera, the present form being a member of the subgenus *Aporodon.* A very young example from the grassy lake at Gatun is doubtfully assigned to this species.

As *Reithrodontomys costaricensis,* a name synonymized by Howell (1914, p. 73) with *R. m. cherrii,* Bangs (1902, p. 39) notes 30 specimens obtained by W. W. Brown, Jr., at from 4,000-6,000 feet altitude near Boquete. Brown found this harvest mouse one of the more common small mammals of the forest belt of the Volcan de Chiriqui.

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[1] Collection Mus. Comp. Zool.

Under the same name Allen (1904, p. 70) records six specimens taken at Boquete by J. H. Batty. Two examples too young for identification listed by Thomas (1903*a*, p. 41) from Cebaco Island near the Pacific coast, may be referable to this form.

Specimens examined: Boquete, 34[1]; Gatun, 1.

Genus PEROMYSCUS Gloger

The genus *Peromyscus* is remarkable for the inclusion of more forms than any other mammalian genus in North America. The species are forest mice, usually with long tails, rather large ears and soft fur. They are usually, but not invariably, distinguishable from the species of *Oryzomys,* a related genus, by the softer fur, larger ears, and smaller, more densely haired, hind feet; several other allied genera are similar externally and difficult to determine without recourse to detailed differential characters presented by the skull. While so numerous in North America in general, very few species range so far south as Panama where they appear to be restricted to the upper slopes of the mountains.

Subgenus PEROMYSCUS Gloger

PEROMYSCUS NUDIPES (Allen)

La Carpintera Mouse

Hesperomys (*Vesperimus?*) *nudipes* Allen, Bull. Amer. Mus. Nat. Hist., Vol. 3, p. 213, April 17, 1891. Type from La Carpintera, Costa Rica.

Peromyscus cacabatus Bangs, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 29, text figs. 8-10, April, 1902. Type from Boquete, Chiriqui, Panama.

Peromyscus nudipes is a large member of the genus, but decidedly smaller than *P. flavidus* which inhabits parts of the same area. It measures 250 to 270 millimeters in total length, while this dimension in the latter species is well over 300 millimeters.

It is known in Panama only from the slopes of the Volcan de Chiriqui where it was collected by W. W. Brown, Jr. It was described by Outram Bangs under the name *P. cacabatus,* which I agree with Allen (1904, p. 67) and Osgood (1909, p. 195) in identifying with *P. nudipes.* Brown found it by far the commonest small mammal of the mountain forest belt of the Volcan de Chiriqui where it does not appear to occur below 4,000 feet and extends thence upward to at least 7,500 feet elevation.

Specimens examined: Boquete, 116[2] (including type).

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[1] Twenty-eight specimens in Mus. Comp. Zool.; six in Amer. Mus. Nat. Hist.

[2] 103 in Mus. Comp. Zool.; 11 in Amer. Mus. Nat. Hist.

Subgenus MEGADONTOMYS Merriam

PEROMYSCUS FLAVIDUS Bangs

Volcan Mouse

Megadontomys flavidus BANGS, Bull. Mus. Comp. Zool., Vol. 39, No. 2, text figs. 5-7, p. 27, April, 1902. Type from Boquete, Volcan de Chiriqui, Panama (altitude 4,000 feet).

Peromyscus flavidus is a large member of the subgenus *Megadontomys,* allied to *P. pirrensis,* but paler, more ochraceous in color, with a shorter hind foot. It differs also in cranial and dental details, especially the tendency to division exhibited by the anterior lobe of the first upper molar.

This species was discovered by W. W. Brown, Jr., in the course of his work for Outram Bangs on the Volcan de Chiriqui. He found it common in the upland forest at from 3,000 to 5,000 feet altitude, but no specimens were taken above or below these elevations. The species thus seems to be restricted to about the same altitudinal range as *P. pirrensis* and the two are apparently isolated by low-lying areas unsuited for their habitation.

Specimens examined: Boquete, 32[1] (including type).

PEROMYSCUS PIRRENSIS Goldman

Mount Pirre Mouse

[Plate 23, figs. 5, 5*a*]

Peromyscus pirrensis GOLDMAN, Smiths. Misc. Coll., Vol. 60, No. 2, p. 5, September 20, 1912. Type from near head of Rio Limon, Mount Pirre, eastern Panama (altitude 4,500 feet).

The Mount Pirre mouse is a large member of the subgenus *Megadontomys.* It is similar to *P. flavidus* of the Volcan de Chiriqui but is decidedly darker, less ochraceous in color, and has a longer hind foot; the skull is larger, with longer, slenderer rostrum; the anterior lobe of the first upper molar is very narrow and in some examples entire, in others slightly notched.

While evidently more closely allied to *P. flavidus* than to any other known form, *P. pirrensis* differs from that species notably in dentition. The anterior lobe of the first upper molar is narrower, less extended internally, and the longitudinal notch is faint or absent. The supplementary cusps are rather weakly developed for a *Megadontomys,* and the general form of the tooth suggests the 5-tuberculate condition of typical *Peromyscus.* In *P. flavidus,* on the contrary, the division of the anterior lobe being more complete the cusp

[1] Twenty-five in collection Mus. Comp. Zool.; five in Amer. Mus. Nat. Hist.

arrangement approaches that in the 6-tuberculate genera *Nyctomys* and *Rhipidomys*.

The discovery of a *Peromyscus* on Mount Pirre materially extended the known range of the genus from the western part of the republic to near the Colombian frontier. The specimens were trapped mainly under logs and among the spreading aerial roots of trees, in the unbroken forest, at from 3,500 feet on the slopes to 5,200 feet altitude near the summit of the mountain. None were taken in numerous traps placed at lower elevations, and the species seems to be limited to the upper slopes of the mountains where it is common. Two young were found in a nest about six feet from the ground behind the expanded base of a palm frond, indicating scansorial habits. The nest was composed of pulverized bark, and plant fibers. Worn places over and under logs mark routes regularly used by the species in moving about on and near the ground. Anthony (1916, p. 366) found this species "the commonest rat of southeastern Panama." Numerous specimens were obtained by him at various elevations from 2,650 feet near the old village of Tacarcuna up to 5,200 feet near Mount Tacarcuna.

Specimens examined: Mount Pirre (type locality), 20; Mount Tacarcuna, 47.[1]

Genus NYCTOMYS Saussure. Vesper Rats

The members of the Middle American genus *Nyctomys* are medium-sized mice of a rich yellowish color above. The underparts are white. The tail is about as long as the body, and clothed with rather long hair. In many respects the genus resembles *Rhipidomys*, but the general color is more yellowish than is usual in that genus, and the tail shorter and clothed with longer hair. The skull is short and broad, with a short, slender rostrum and fully expanded braincase. The frontals are much broader than in *Rhipidomys*, the lateral margins projecting well over the orbits. The first upper molar is a rectangular tooth with six tubercles much as in *Rhipidomys*, but in the less complete division of the anterior lobe and the reduced size of the anterointernal cusp suggests gradation toward the 5-tuberculate genus *Peromyscus*.

[1] Collection Amer. Mus. Nat. Hist.

NYCTOMYS SUMICHRASTI NITELLINUS Bangs

Chiriqui Vesper Rat

Nyctomys nitellinus Bangs, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 30, text figs. 11-12, April, 1902. Type from Boquete, Chiriqui, Panama (altitude 4,000 feet).

Nyctomys sumichrasti nitellinus is comparatively pale and yellowish in color above, the general tone decidedly paler than in the allied subspecies, *Nyctomys sumichrasti venustulus* of Nicaragua and Costa Rica, which differs also in the narrower braincase and posterior part of frontal region.

The subspecies is based on six specimens obtained by W. W. Brown, Jr., at the type locality.

Genus RHIPIDOMYS Tschudi. Climbing Mice

Rhipidomys is one of those genera found during the present investigations to range within the limits of Panama. Externally the species resembles some forms of *Oryzomys;* the tail is very long and clothed with rather long hair; the hind feet are short with sharp, strongly curved claws adapting the animal for an arboreal life; cranial examinations are, however, important in order to make accurate generic determinations. The skull of *Rhipidomys* resembles that of *Nyctomys* in many respects, the braincase being large and the rostrum short and narrow. The frontal region is narrower, however, the incisive foramina much longer than the palatal bridge and reaching posteriorly behind the anterior plane of the first molars. The genus *Rhipidomys* differs from *Nyctomys* notably in the form of the anterior upper molar, this tooth bearing six well-developed cusps, while in *Nyctomys* the anterointernal cusp is less prominent and suggests gradation toward the normally 5-tuberculate genus *Peromyscus.*

RHIPIDOMYS SCANDENS Goldman

Mount Pirre Climbing Mouse

[Plate 23, figs. 4, 4*a*]

Rhipidomys scandens Goldman, Smiths. Misc. Coll., Vol. 60, No. 22, p. 8, February 28, 1913. Type from near head of Rio Limon, Mount Pirre, eastern Panama (altitude 5,000 feet).

The type of *Rhipidomys scandens* is unique, and no other specimens of the genus are known from any part of Middle America. The species is closely allied to *R. venezuelæ* with which it may be expected to intergrade, but until more material is available and the

various forms of this unrevised group are better known, it seems preferable to treat the Panama representative of the genus as a distinct species. The upperparts are darker colored than in typical examples of *R. venezuelæ* and the skull is decidedly broader across the braincase. In the breadth of the braincase it is similar to *R. cocalensis,* another closely related form, but the frontal region is depressed anteriorly and much narrower, especially posteriorly, the maxillary arm of the zygoma is heavier, and the interparietal is larger.

The specimen which became the type was secured just at dusk one evening, when it was seen running rapidly up the trunk of a tree near my camp in the forest, to a point about 35 feet from the ground where the tree was encircled by a mass of Bromeliaceous plants. The mouse paused a moment among the leaves, its long tail hanging straight downward, and was shot.

Specimens examined: Mount Pirre, 1.

Genus TYLOMYS Peters

The members of the genus *Tylomys* bear some superficial resemblance to large examples of *Mus rattus.* The ears are large and naked, the tail is long and practically bare, the skin of the terminal portion whitish or flesh colored instead of black. The skull is elongated, with low rather flat braincase, and broad frontals which form supraorbital shelves much as in *Nyctomys.* The outer wall of the antorbital foramen is little developed forward, the anterior border concave. The first upper molar is evenly rectangular with six well-developed tubercles arranged about as in *Rhipidomys.*

TYLOMYS PANAMENSIS (Gray)

Panama Climbing Rat

Neomys panamensis Gray, Ann. Mag. Nat. Hist., Ser. 4, Vol. 12, p. 417, November, 1873. Type from Panama.

The Panama climbing rat was described from a specimen obtained by the British Museum through M. Boucard. To this species I provisionally refer three immature specimens with narrow, elongated skulls, taken near Cana. In cranial characters they are much like *T. miræ,* however, and quite different from a comparably immature example from Cerro Brujo which may represent *T. watsoni.*

One of the specimens was taken in a banana-baited trap placed among rocks at 2,000 feet altitude near the entrance to an abandoned tunnel at the Darien gold mines. One caught in a trap set under a

log along the bank of a stream in the forest at 4,500 feet altitude was devoured by some prowling animal. Another was shot in the same vicinity one day by one of my men, as it climbed a palm frond 30 feet from the ground. This was a full-grown animal, but, unfortunately, the head was carried away by the shot and the specimen rendered worthless.

Specimens examined: Cana, 3.

TYLOMYS WATSONI Thomas

Watson's Climbing Rat

Tylomys watsoni Thomas, Ann. Mag. Nat. Hist., Ser. 7, Vol. 4, p. 278, October, 1899. Type from Bugaba, Chiriqui, Panama (altitude 800 feet).

The basis of this species was two specimens "caught on banks of river" at Bugaba by H. J. Watson. The skull is described as much broader and heavier than that of *T. panamensis*. Bangs (1902, p. 32) notes four examples, collected by W. W. Brown, Jr., of which he says: "The specimens from Bugaba are not only topotypes, but were caught on the banks of the same stream as the type." Allen (1904, p. 68) lists a specimen taken by J. H. Batty at Boqueron.

An immature example from Cerro Brujo, with a broad, heavy skull, is quite different from the Cana series and more like *T. watsoni* to which it is provisionally referred, although the nasals and premaxillæ are conterminous posteriorly (in specimens of typical *watsoni* the premaxillæ exceed the nasals in posterior extent). It was taken in a trap placed among the spreading aerial roots of a palm at 1,000 feet elevation on the Atlantic slope of the mountain.

Specimens examined: Bugaba (type locality), 3[1]; Boqueron, 1; Boquete, 1[1]; Cerro Brujo, 1.

TYLOMYS FULVIVENTER Anthony

Fulvous-bellied Climbing Rat

Tylomys fulviventer Anthony, Bull. Amer. Mus. Nat. Hist., Vol. 35, p. 366, June 9, 1916. Type from Mount Tacarcuna, Panama (altitude 4,200 feet).

The type and only known specimen of this species seems sufficiently distinguished by the russet and ochraceous-buffy colors of the underparts. In the other species inhabiting the general region the underparts are white. Additional examples are much needed in order to determine the status and relationships of the various forms of the genus. Anthony (*l. c.*) states that this rat was taken in a banana-

[1] Collection Mus. Comp. Zool.

baited trap set at the foot of a large tree in the fairly heavy forest that clothes Mount Tacarcuna.

Specimens examined: The type.[1]

Genus SCOTINOMYS Thomas. Brown Mice

The members of the genus *Scotinomys* are very small blackish or dark brownish mice with soft pelage and tails shorter than the head and body. Several species have been described and the group ranges from southern Mexico to western Panama. Until recently [2] the species were included in the genus *Akodon* which, by the segregation of this Middle American group, becomes eliminated from the North American fauna. *Scotinomys* differs from *Akodon* in dental details, the molars being narrower and more elongated in the antero-posterior direction. The lateral compression is especially noticeable in the posterior portion of the first upper molar. An inner view of this tooth shows the posterointernal reentrant angle extending as a deep groove to the alveolar border and in advanced age three root divisions are visible instead of two as in *Akodon*. The lower incisor lacks a tubercular swelling over the root.

SCOTINOMYS TEGUINA APRICUS (Bangs)

Boquete Brown Mouse

Akodon teguina apricus Bangs, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 40, text figs. 20-21, April, 1902. Type from Boquete, Chiriqui, Panama (altitude, 4,000 feet).

Scotinomys t. apricus is based on five specimens collected by W. W. Brown, Jr., at from 4,000 to 5,000 feet altitude near Boquete on the basal slope of the Volcan de Chiriqui.

The original description is in part as follows:

"Colors not so black as in true *A. teguina* (the rump and thighs in true *A. teguina* are blackish, in the new form they are scarcely darker than the rest of the upper parts); tail, longer; ears, larger; skull, heavier; rostrum, heavier; molar-form teeth much heavier; tooth rows not so parallel,—much more divergent anteriorly. Pelage, short, close, and fine with decided gloss.

"Upper parts vandyke-brown, slightly more dusky on top of head and along middle of back; under parts dull cinnamon rufous; hands, feet, ears, and tail blackish.

[1] Collection Amer. Mus. Nat. Hist.

[2] See Thomas, Ann. Mag. Nat. Hist., Ser. 8, Vol. 11, p. 408, April, 1913.

"Through the kindness of Dr. Merriam I was able to compare the series taken by Mr. Brown with a fine adult ♂, No. 76,353, of true *A. teguina* taken by Mr. E. W. Nelson at Ocuilapa, Chiapas, Mexico. This comparison showed that the Chiriqui animal is quite distinct—though it is perhaps better to regard it as a subspecies.

"Mr. Brown caught all five of these curious dark brown little creatures, in open rocky places." (Bangs, *l. c.*)

No representative of the genus was met with by me in the course of extended field work in eastern Panama where the Isthmus is heavily forested from coast to coast.

Specimens examined: Boquete, 5[1] (including type).

SCOTINOMYS XERAMPELINUS (Bangs)

Chiriqui Brown Mouse

Akodon xerampelinus Bangs, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 41, text figs. 22-23, April, 1902. Type from Volcan de Chiriqui, Chiriqui, Panama (altitude, 10,300 feet).

Three specimens obtained by W. W. Brown, Jr., near the summit of the Volcan de Chiriqui are the basis of this species, of which the following is the original description in part:

"Apparently specifically distinct from *A. teguina*. Size of that species; tail, longer; pelage very long and fluffy with but little lustre; colors, paler—more yellowish, less reddish brown; under parts grayish (strong cinnamon rufous in *A. teguina*); skull lighter and more delicate; rostrum lighter; nasals narrower; palatal slits rather wider; audital bullæ slightly larger; molar-form teeth heavier—wider.

"Upper parts uniform dark yellowish brown (a color that might perhaps be called tawny burnt-umber) under parts, broccoli-brown; hands, feet, tail, and ears, blackish (slightly grayer, less intense black than these parts in *A. teguina apricus;* due to greater hairiness).

"The little Akodon of the summit of Volcan de Chiriqui is very different from the one found at lower altitudes and is entitled to full specific rank. The three examples were taken on the desolate top of the Volcano, a little below actual timber line, but still where the forest had become stunted and sparse. Like *A. teguina apricus* they were found in open rocky country." (Bangs, *l. c.*)

Scotinomys irazu, a high mountain form of Costa Rica, seems to be somewhat smaller and paler in color.

Specimens examined: Volcan de Chiriqui, 3[1] (including type).

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[1] Collection Mus. Comp. Zool.

Genus ZYGODONTOMYS Allen. Cane Rats

The genus *Zygodontomys* includes medium-sized, ground-inhabiting rodents which are grayish-brown in general coloration, with tails shorter than the head and body. The members are similar to *Oryzomys* in external appearance, but may usually be distinguished by the proportionately shorter tail and shorter hind feet. Recourse to the skull may, however, be necessary in order to make accurate determinations, generic distinction being lodged mainly in dental details, especially the absence of distinct style and stylid ridges and the presence of straight, antero-posteriorly directed commissures in the molar crowns. In Panama *Zygodontomys* superficially resembles the cotton rat, *Sigmodon*, but the ears are smaller and the light and dark elements of the pelage, more finely mixed, produce a less coarsely grizzled combination of color.

ZYGODONTOMYS CHERRIEI CHERRIEI (Allen)

Cherrie's Cane Rat

Oryzomys cherriei Allen, Bull. Amer. Mus. Nat. Hist., Vol. 7, p. 329, November 8, 1895. Type from Boruca, Costa Rica.

The range of Cherrie's cane rat extends from Costa Rica into Panama where it was first recorded by Bangs (1902, p. 37) on the basis of a young example collected by W. W. Brown, Jr., at Bugaba. He says: "I have compared this example with topotypes, kindly loaned by Dr. Allen and can find no differences." The species was noted by Thomas (1903*a*, p. 40) from Cebaco Island, near the coast of Chiriqui, whence it was sent by J. H. Batty. Allen (1904, p. 69) lists 11 specimens taken at Boqueron by the same collector.

Zygodontomys cherriei is replaced in the Canal Zone by *Z. c. ventriosus*, a larger, paler animal, with the back more uniform in color, less distinctly darkened along the median line.

Specimens examined: Boqueron, 11[1]; Bugaba, 1[2]; El Banco, 1.

ZYGODONTOMYS CHERRIEI VENTRIOSUS Goldman

Canal Zone Cane Rat

Plate 23, figs. 3, 3*a*

Zygodontomys cherriei ventriosus Goldman, Smiths. Misc. Coll., Vol. 56, No. 36, p. 8, February 19, 1912. Type from Tabernilla, Canal Zone, Panama.

The Canal Zone form of *Zygodontomys cherriei* is closely allied to the typical form, *Z. c. cherriei*, but is larger and paler in color,

[1] Collection Amer. Mus. Nat. Hist.

[2] Collection Mus. Comp. Zool.

the back less distinctly darkened along the median line. It seems to be the most abundant murine rodent in the grassy clearings, sugar-cane fields, and second growth forest of the region. It was not obtained in the heavy forest and in all probability greatly increased in numbers with the clearing of forest along the line of the Panama Railroad. With the completion of the Gatun dam and the elevation of the level of Gatun Lake much of the cleared space, including the type locality, has been flooded, and the area in which these rice rats and other small rodents were thriving is again restricted. Anthony (1916, p. 368), who visited the Canal Zone early in 1914, reports " This species was found but rarely. It was taken only at low elevations." He records specimens from Gatun, Real de Santa Maria and Old Panama.

Specimens examined: Empire, 4; Gatun, 12[1]; Real de Santa Maria, 1[1]; Old Panama, 1[2]; Tabernilla (type locality), 15.

ZYGODONTOMYS SEORSUS Bangs

San Miguel Island Cane Rat

Zygodontomys seorsus Bangs, Amer. Nat., Vol. 35, p. 642, August, 1901. Type from San Miguel Island, Panama.

San Miguel Island is inhabited by a large, well-marked species, differing from the form of *Z. cherriei* inhabiting the adjacent mainland in much larger size, and much darker, ferruginous coloration.

The basis of the species is a series of 68 specimens collected by W. W. Brown, Jr.

In remarks accompanying the original description, Bangs (*l. c.*) states that " The San Miguel vesper rat is a strongly marked island species, most nearly related to *Z. brevicauda,* of Trinidad, which it precisely resembles in color and character of pelage. Its much greater size, bigger foot, and different tail distinguish it, externally, from the Trinidad species, and the skulls of the two can easily be distinguished.

Z. seorsus was an abundant animal in San Miguel Island, inhabiting the dense, swampy woods, and Mr. Brown found no difficulty in trapping it in numbers."

Specimens examined: San Miguel Island, 54.

Genus NEACOMYS Thomas. Bristly Mice

The members of the genus *Neacomys* are very small, handsome mice related to *Oryzomys,* but with pelage composed of grooved

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[1] Four in collection Amer. Mus. Nat. Hist.

[2] Collection Amer. Mus. Nat. Hist.

spines or bristles mixed with slender hairs much as in the unrelated genus *Heteromys*. This genus is one of those whose occurrence within our limits was disclosed during the field work in connection with the present investigations.

NEACOMYS PICTUS Goldman

Painted Bristly Mouse

[Plate 23, figs. 2, 2*a*]

Neacomys pictus Goldman, Smiths. Misc. Coll., Vol. 60, No. 2, pp. 6-7, September 20, 1912. Type from Cana, eastern Panama (altitude 1,800 feet).

This handsome little mouse is one of the smaller rodents of the region. The pelage of the upperparts is composed of grooved black-tipped spines or bristles and slender orange rufous hairs. The mouse is easily recognized by the bristly pelage, rich orange rufescent coloration, and the absence of the external cheek pouches present in *Heteromys*.

The adults present remarkably slight variation in size or color, the orange rufous hairs mixed with the black-tipped spines producing a uniformly grizzled effect over the upperparts. The underparts are white, the color changing abruptly below a sharp ochraceous buffy line of demarcation along the sides. A half-grown young individual is in a comparatively soft pelage corresponding to the immature coat seen in *Heteromys* and other genera.

The species seems to be related to *N. pusillus* from the coast region of western Colombia, but is a larger animal with white instead of yellowish feet. The specimens were trapped in grass and small bushes growing among rocks along the edge of a sugar-cane field at 1,800 to 2,000 feet elevation on a steep mountain side near the Darien gold mines. Anthony (1916, p. 369) records the species from a slightly higher altitude, 2,650 feet at the village of Tacarcuna and remarks: "The genus was not encountered elsewhere."

Specimens examined: Cana (type locality), 5; Tacarcuna, 2.[1]

Genus ORYZOMYS Baird. Rice Rats

The genus *Oryzomys* seems to occupy in South America the place filled in North America by the genus *Peromyscus*, as the Murine group including the greatest number of species. But from South America *Oryzomys* pushes northward through Middle America, considerably overlapping the range of *Peromyscus*. In this genus the size is very variable, some forms being so small and slender that in

[1] Collection Amer. Mus. Nat. Hist.

the flesh they are most easily distinguished from *Reithrodontomys* by the smooth instead of grooved upper incisors; others are as large as common rats. The short ears, usually harsh fur, and rather long, thinly haired hind feet will aid in the recognition of the rice rats among the numerous small rodents of the region.

Subgenus ORYZOMYS Baird

ORYZOMYS GATUNENSIS Goldman

Gatun Rice Rat

[Plate 24, figs. 2, 2*a*]

Oryzomys gatunensis Goldman, Smiths. Misc. Coll., Vol. 56, No. 36, p. 7, February 19, 1912. Type from Gatun, Canal Zone, Panama.

The Gatun rice rat is a member of the *O. palustris* group allied to *O. richmondi* of Nicaragua, contrasted with which it is paler, more grayish brown in color; the skull differs in detail, the frontals being decidedly broader with lateral margins more developed as supraorbital shelves; the interparietal is much less extended anteroposteriorly and the nasals are more prolonged posteriorly beyond the premaxillæ.

The type and only known specimen is a young individual which seems to require comparison only with *O. richmondi.* It was trapped in an abandoned sugar-cane plantation on the bank of the Chagres River.

Specimens examined: Gatun, 1 (type).

ORYZOMYS ALFAROI ALFAROI Allen

Alfaro's Rice Rat

Hesperomys (*Oryzomys*) *alfaroi* Allen, Bull. Amer. Mus. Nat. Hist., Vol. 3, p. 214, April 17, 1891. Type from San Carlos, Costa Rica.

Alfaro's rice rat is a small, slender, dark colored species which ranges into western Panama from Costa Rica. It is closely allied to *O. a. dariensis* of the mountains of the eastern part of the republic. Contrasted with that subspecies the present form is duller, less rufescent in coloration.

Specimens collected by W. W. Brown, Jr., at 4,000 feet altitude near Boquete are recorded by Bangs (1902, p. 33).

Specimens examined: Boquete, 14.[1]

[1] Eleven in collection Mus. Comp. Zool.; two in Field Mus. Nat. Hist.; one in Amer. Mus. Nat. Hist.

ORYZOMYS ALFAROI DARIENSIS Goldman

Darien Rice Rat

[Plate 24, figs. 1, 1*a*]

Oryzomys alfaroi dariensis GOLDMAN, Proc. Biol. Soc. Washington, Vol. 28, p. 128, June 29, 1915. Type from Cana, eastern Panama (altitude 2,000 feet).

In the richer, more reddish coloration of the upperparts, and usually narrower skull the Darien rice rat differs from the closely allied form, Alfaro's rice rat of western Panama. The Darien animal is rather common in dense thickets at 2,000 to 2,500 feet altitude along the Cana River, near Cana. The same thickets are also inhabited, apparently in smaller numbers, by *O. talamancæ*. On Mount Tacarcuna an immature example recorded by Anthony (1916, p. 368) was secured at 5,200 feet.

Specimens examined: Cana, 11; Mount Tacarcuna, 1.[1]

ORYZOMYS BOMBYCINUS BOMBYCINUS Goldman

Silky Rice Rat

[Plate 24, figs. 3, 3*a*]

Oryzomys bombycinus GOLDMAN, Smiths. Misc. Coll., Vol. 56, No. 36, p. 6, February 19, 1912. Type from Cerro Azul, near headwaters of Chagres River, Panama (altitude 2,500 feet).

The silky rice rat is a dark-colored, forest-inhabiting species with remarkably long, soft pelage for an *Oryzomys*. It was originally compared with *O. carrikeri* and *O. talamancæ,* but is much more nearly related to *O. nitidus* from Peru, as represented by specimens in the National Museum determined by Mr. Oldfield Thomas. *O. bombycinus* differs from *O. nitidus* most noticeably in cranial characters, the braincase being broader, the zygomata more widely spreading posteriorly (zygomata more nearly parallel in *nitidus*), and the audital bullæ larger.

On Cerro Azul a few of these rice rats were taken in traps placed mainly under logs and about the bases of large forest trees at from 2,500 to 3,000 feet elevation near the summit of the mountain. No examples of this species were obtained in the course of extensive field work at the same elevation on the higher mountains near the Colombian frontier. A single individual was taken at about 1,000 feet on the forested basal slope of Cerro Brujo where *O. talamancæ* also occurs.

Specimens examined: Cerro Azul (type locality), 3; Cerro Brujo, 1.

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[1] Collection Amer. Mus. Nat. Hist.

ORYZOMYS TALAMANCAE Allen

Talamanca Rice Rat

Oryzomys talamancæ Allen, Proc. U. S. Nat. Mus., Vol. 14, p. 193, July 24, 1891. Type from Talamanca, Costa Rica. (Probably near Sipurio, in the valley of the Rio Sicsola.)

Oryzomys panamensis Thomas, Ann. Mag. Nat. Hist., Ser. 7, Vol. 8, p. 252, September, 1901. Type from City of Panama, Panama.

The Talamanca rice rat typifies a group of wide distribution in South America; *O. mollipilosus* and *O. medius* are closely allied Colombian and Venezuelan forms, and others range as far as Brazil. The pelage in *O. talamancæ* is short and close and the general color varies in rich rufescent tones.

It was originally described from Costa Rica and is generally distributed in Panama where it is one of the more abundant species, ranging from sea level in the Canal Zone to 2,500 feet altitude on the slopes of the mountains near the Colombian frontier. Specimens were trapped mainly under logs and rocks and about the bases of large trees in the heavy forest.

Specimens from the Canal Zone which I identify with *O. talamancæ* have been submitted to Mr. Oldfield Thomas for comparison with the type of *O. panamensis* in the British Museum. Regarding them he has written as follows: " We have only one specimen of *O. panamensis* and it is both larger and more rufous than your specimens. But it is older; the skull agrees in general characters and the tooth-row is of exactly the same length. As to the colour I think the difference is only due to the coming on of the faded fulvous stage found in the old specimens of most species of *Oryzomys*. Personally I should certainly refer your specimens to *panamensis*." On the basis of this comparison and other grounds *O. panamensis* seems to belong in synonymy under *O. talamancæ*. Anthony (1916, p. 369) states " the species was found sparingly throughout the lowlands from the Canal Zone to the Darien." He records specimens from Cituro, Maxon Ranch (Rio Trinidad), Tacarcuna and Tapalisa.

Specimens examined: Cana, 7; Cituro, 1 [1]; Cerro Brujo, 1; Gatun, 6; Maxon Ranch (Rio Trinidad), 3 [1]; Tacarcuna, 1 [1]; Tapalisa, 9.[1]

ORYZOMYS DEVIUS Bangs

Boquete Rice Rat

Oryzomys devius Bangs, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 34, text figs. 13-14, April, 1902. Type from Boquete, Chiriqui, Panama (altitude 5,000 feet).

The Boquete rice rat is a large species of a group which includes *O. meridensis* and a number of other South American forms. No

[1] Collection Amer. Mus. Nat. Hist.

other member of the group is known to range so far into Middle America, but an allied species, *O. pirrensis,* inhabits the mountains of eastern Panama. The underparts in *O. devius,* unlike those of *O. pirrensis,* are marked by white patches, as usual in the group. The skull is similar, but more smoothly rounded, the zygomata less widely spreading, the supraorbital and temporal ridges less distinct, and the audital bullæ decidedly larger than in *O. pirrensis.*

The species is based on four specimens obtained by W. W. Brown, Jr., from 4,000 to 5,000 feet altitude on the southern slope of the Volcan de Chiriqui, and additional examples from the same locality acquired by the Field Museum of Natural History.

Specimens examined: Boquete (type locality), 6.[1]

ORYZOMYS PIRRENSIS Goldman

Mount Pirre Rice Rat

[Plate 24, figs. 5, 5*a*]

Oryzomys pirrensis GOLDMAN, Smiths. Misc. Coll., Vol. 60, No. 22, pp. 5-6, February 28, 1913. Type from near head of Rio Limon, Mount Pirre, eastern Panama (altitude 4,500 feet).

The Mount Pirre rice rat is a large member of the *O. meridensis* group. It is similar in size to *O. devius* of western Panama, but slightly darker in general color, and the underparts lack the pure white patches usual in the group. The skull is more angular, with zygomata more widely spreading, the supraorbital and temporal ridges more distinct, and the audital bullæ decidedly smaller. The skull combines the large general size of that of *O. devius* with the small audital bullæ of *O. meridensis* and *O. maculiventer;* it differs from both, however, in the development of the supraorbital and temporal ridges.

Like the allied species, *O. devius, O. meridensis* and others of the group, this large rice rat is an inhabitant of the mountains. It was found only in the heavy forest at about 4,500 feet altitude where precipitous slopes border the narrow canyon of the Rio Limon. The animals live in holes under logs and rocks along steep overhanging banks of the stream, where palms and tree ferns are conspicuous vegetation. Several were caught in well-worn paths, bearing many marks of small feet.

Anthony (1916, p. 368) encountered this species at 5,200 feet on the upper slope of Mount Tacarcuna where it did not appear to be common. He notes the external resemblance to the much more

[1] Four in collection Mus. Comp. Zool.; two in Field Mus. Nat. Hist.

abundant species, *Peromyscus pirrensis,* occurring at the same locality, and points out the more naked tail and shorter ears as distinguishing characters.

Specimens examined: Mount Pirre, 8; Mount Tacarcuna, 6.[1]

ORYZOMYS TECTUS TECTUS Thomas

Bugaba Rice Rat

Oryzomys tectus Thomas, Ann. Mag. Nat. Hist., Ser. 7, Vol. 8, p. 251, September, 1901. Type from Bugaba, Chiriqui, Panama (altitude 800 feet).

The two closely allied forms of *O. tectus* are large, rather robust rice rats with generally rich tawny or ochraceous-tawny upperparts. The underparts vary from nearly pure white to pale buff. The skulls are remarkable for the lateral expansion of the frontals as supraorbital shelves. These forms are typical of a group including *O. flavicans* and other South American species. *O. t. tectus,* known only from western Panama and Costa Rica, differs from *O. t. frontalis* of eastern Panama in the brighter tawny coloration of the upperparts and the more buffy underparts. Aside from the type no specimens appear to have been collected in Panama, but two examples from Boruca, Costa Rica, are assumed to be typical.

ORYZOMYS TECTUS FRONTALIS Goldman

Corozal Rice Rat

[Plate 24, figs. 6, 6*a*]

Oryzomys frontalis Goldman, Smiths. Misc. Coll., Vol. 56, No. 36, p. 6, February 19, 1912. Type from Corozal, Canal Zone (altitude 100 feet).

Oryzomys t. frontalis of eastern Panama is closely allied to *O. t. tectus* of western Panama, but the upperparts are duller, less distinctly tawny, and the underparts are whiter, less extensively buffy. It is decidedly larger than the related South American forms, *O. flavicans* and *O. f. illectus,* and differs in cranial details, especially the greater lateral projection of the frontals over the orbits.

At Corozal the type was trapped in grass and bushes near the edge of a swamp a few feet above sea level. Near Cana specimens were taken at 2,000 feet altitude in an abandoned sugar-cane field where a rank growth of grass and shrubbery was springing up. Here it was associated with the Panama dusky rice rat (*Oryzomys caliginosus idoneus*), a much more abundant species. Anthony (1916, p. 369) records a specimen from the village of Tacarcuna.

Specimens examined: Cana, 11; Corozal, 1; Tacarcuna, 1.[1]

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[1] Collection Amer. Mus. Nat. Hist.

Subgenus OLIGORYZOMYS Bangs

ORYZOMYS FULVESCENS COSTARICENSIS Allen

Costa Rican Pygmy Rice Rat

Oryzomys costaricensis Allen, Bull. Amer. Mus. Nat. Hist., Vol. 5, p. 329, September 22, 1893. Type from El General, Costa Rica (altitude 2,150 feet).

The Costa Rican pygmy rice rat is a very small form closely resembling some species of *Reithrodontomys* from which it may be easily distinguished in the flesh by the smooth instead of grooved upper incisors. It differs from *O. f. fulvescens* of Mexico mainly in the larger molar teeth, and from *O. f. vegetus* of the Volcan de Chiriqui in smaller size and usually paler color.

Very few specimens have been taken in Panama and the subspecies appears to be restricted to the savanna region from the Costa Rican frontier eastward along the Pacific coast. Anthony (1916, p. 368) records two specimens taken by him on the savanna near Old Panama, and the range of the animal probably extends as far east as Chepo.

Specimens examined: La Chorrera, 1 [1]; Old Panama, 2.[1]

ORYZOMYS FULVESCENS VEGETUS Bangs

Volcan Chiriqui Pygmy Rice Rat

Oryzomys (*Oligoryzomys*) *vegetus* Bangs, Bull. Mus. Comp. Zool., Vol. 39, text fig. 15, p. 35, April, 1902. Type from Boquete, Volcan de Chiriqui, Panama (altitude 4,000 feet).

Larger average size and a tendency toward darker coloration usually distinguish this small rice rat from *O. f. costaricensis* which inhabits lower elevations.

Five specimens collected by W. W. Brown, Jr., at 3,800 to 4,800 feet altitude near Boquete were referred by Bangs (1902, p. 35) to *O. f. costaricensis* and 13 others from the same locality were at the same time described by him as a new species, *O. vegetus*. *O. vegetus* Bangs was regarded as identical with *costaricensis* by Allen (1904, p. 69), who says: "The type and 12 topotypes of *O. vegetus* kindly sent me for examination by Mr. Bangs do not differ appreciably from the type, three topotypes, and additional Costa Rican specimens of *O. costaricensis*. They also agree with the seven Boquete specimens collected by Mr. Batty, which I unhesitatingly refer to *O. costaricensis*." The specimens assigned by Bangs to *costaricensis* are rather pale and probably indistinguishable by color from many

[1] Collection Amer. Mus. Nat. Hist.

examples of that form, but the larger size, especially noticeable in the skulls, seems to place them with the remainder of the series of *vegetus*.

Specimens examined: Boquete (type locality), 27.[1]

Subgenus MELANOMYS Thomas

ORYZOMYS CALIGINOSUS IDONEUS Goldman

Panama Dusky Rice Rat

[Plate 24, figs. 4, 4*a*]

Oryzomys idoneus GOLDMAN, Smiths. Misc. Coll., Vol. 56, No. 36, p. 5, February 19, 1912. Type from Cerro Azul, near headwaters of Chagres River, Panama (altitude 2,500 feet).

The forms of *Oryzomys caliginosus* range over an extensive area in northwestern South America and northward in Middle America to Nicaragua. Specimens from widely separated regions exhibit the general characters of the species with remarkable constancy and some of the forms now recognized may ultimately prove to be not well founded. *O. c. idoneus* is much like *O. c. columbianus* of northern Colombia from which it is barely recognizable by slightly darker average color and shorter tail. It differs from typical *O. c. caliginosus* of Ecuador in paler, more tawny, instead of russet coloration. Compared with the more northern form, *O. c. chrysomelas*, it is paler and the skull is more constricted between the orbits, the supraorbital borders less projecting laterally.

"*O. phaeopus*" (*O. c. caliginosus*) was made the type of the subgenus *Melanomys*[2] by Thomas, who mentions its short tail and generally Akodont external form, Oryzomyine molars, broad rounded braincase, short muzzle and well-marked supraorbital ridges. The molar crowns are, however, slightly higher than in typical *Oryzomys* and the lachyrmal articulates mainly with the maxilla. The skull differs also in the lateral expansion of the inner wall of the antorbital foramen whereby the broad, rounded antorbital opening of typical *Oryzomys* viewed from above is reduced to a shallow notch.

O. c. idoneus is the most abundant small rodent in the mixed growth of grass, bushes and small trees at 1,800 to 2,000 feet altitude in the Cana Valley and along the bottom of the canyon of the Cana

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[1] Fifteen in collection Mus. Comp. Zool.; seven in Field Mus. Nat. Hist.; five in Amer. Mus. Nat. Hist.

[2] The subgenus *Melanomys* has been raised to generic rank by Allen (1913, p. 533) but owing to close agreement with typical *Oryzomys* in dentition and other essential characters such generic recognition seems of very doubtful advisability.

River. It was also taken in smaller numbers in the forest at various elevations up to 2,800 feet on the slopes of the Pirre Range. At the type locality on Cerro Azul it appeared to be rather scarce. Like *Nectomys alfari efficax, Sylvilagus gabbi messorius* and other species living on the ground, this rice rat has evidently increased in numbers, locally, with the clearing of the original forest, the new low growth springing up doubtless providing more suitable food and cover than is found in the heavy forest where seed producing undergrowth is largely crowded out. Anthony (1916, p. 369) found the species quite common in the clearing at 2,650 feet at the old village of Tacarcuna, but it seemed rarer at lower elevations and was not taken above 4,200 feet. He records specimens from El Real, Tacarcuna, Maxon Ranch (Rio Trinidad) and Gatun.

Specimens examined: Cana, 46; Cerro Azul, 1 (type); Gatun, 1[1]; Maxon Ranch (Rio Trinidad), 3[1]; Real de Santa Maria, 2[1]; Tacarcuna, 23.[1]

ORYZOMYS CALIGINOSUS CHRYSOMELAS Allen

Costa Rican Dusky Rice Rat

Oryzomys chrysomelas Allen, Bull. Amer. Mus. Nat. Hist., Vol. 9, p. 37, March 11, 1897. Type from Suerre, Costa Rica.

Under the name *Zygodontomys chrysomelas,* Bangs (1902, p. 37) noted three specimens of this subspecies collected for him at Bogava by W. W. Brown, Jr. These have been referred by Allen (1904, p. 548) in his revision of the group to *Melanomys chrysomelas* with the remark that topotypes "agree perfectly with Chiriqui and Nicaragua specimens of corresponding age." The range of the subspecies is given by him as approximately from Bugaba, Chiriqui, Panama, north to northern Nicaragua.

Specimens examined: Bogava, 3.[2]

Genus NECTOMYS Peters

Members of the genus *Nectomys,* especially the smaller species, externally resemble some species of *Oryzomys.* The genus is nearly related to *Oryzomys* from which it differs notably in rather more hypsodont dentition; the molar crowns have lower tubercles and the outer reentrant angles are shallower so that with continued wear on the crowns the latter close along the outer side, but remain as deep interior enamel folds or islands which persist to extreme old age,

[1] Collection Amer. Mus. Nat. History.
[2] Collection Mus. Comp. Zool.

the result being a more complicated enamel pattern than in *Oryzomys*. Some of the South American species of *Nectomys* are the largest American Murine rodents.

NECTOMYS ALFARI EFFICAX Goldman

Cana Rice Rat

[Plate 23, figs. 6, 6*a*]

Nectomys alfari efficax Goldman, Smiths. Misc. Coll., Vol. 60, No. 22, p. 7, February 28, 1913. Type from Cana, eastern Panama (altitude 1,800 feet).

Nectomys a. efficax is a richly colored, long-haired animal belonging to the section of the genus including rather small species—*N. esmeraldarum* and others—which lack the fringed feet and toes of the more typical *Nectomys squamipes* group. In the more essential characters, however, the two groups are closely congeneric. *N. a. efficax* is closely allied to *N. a. alfari*[1] of Costa Rica. It differs, however, in the richer, more tawny ochraceous coloration of the upperparts and the skull has a narrower braincase and more massive rostrum. It is somewhat similar to *N. esmeraldarum*, but larger, the color paler, more ochraceous, and the skull more elongated. *N. dimidiatus* of Nicaragua is a much smaller species with a different skull.

This rice rat is one of the more common Murine rodents in the grassy clearings, old cane fields and second growth forest at 1,800 to 2,000 feet altitude on the small plateau commonly known as the Cana Valley. It was especially abundant in the rank grass growing on the marshy valley bottom. No examples were taken in the heavy forest. In examining specimens in the flesh it was noted that the number of tubercles on the sole of the hind foot is variable. In some examples there are five with no trace of a sixth; in others six are distinctly shown, but the postero-external may be very small; in still others the small sixth tubercle is present, but very minute on one foot and absent on the other. Anthony (1916, p. 369) found the Cana rice rat common at 2,650 feet at the village of Tacarcuna, but it "strangely was not taken elsewhere."

Specimens examined: Cana, 23; Tacarcuna, 15.[2]

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[1] This species was described as the type of a new genus, *Sigmodontomys* Allen (Bull. Amer. Mus. Nat. Hist., Vol. 9, p. 39, March 11, 1897), which is clearly identical with *Nectomys* Peters.

[2] Collection Amer. Mus. Nat. Hist.

Genus SIGMODON Say and Ord. Cotton Rats

The members of this genus attain the size of common rats, but are more robust in form with tails usually shorter than the body, rather thick at the base and tapering rapidly to slender tips. The ears are short, but broad and clothed with short fur. The pelage is coarse, and grizzled grayish brown in general color. The skulls are easily distinguished by a spinous process projecting forward from the upper edge of the outer wall of the antorbital foramen.

SIGMODON HISPIDUS CHIRIQUENSIS Allen

Boqueron Cotton Rat

Sigmodon borucæ chiriquensis Allen, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 68, February 29, 1904. Type from Boqueron, Chiriqui, Panama.

The Boqueron cotton rat is very similar to *S. h. borucæ* of Costa Rica, but the upperparts are somewhat richer, more rufescent in general tone. The underparts are usually white, but in both forms they are sometimes suffused with buff.

The basis of the subspecies is six specimens collected at Boqueron by J. H. Batty. Alston (1879, p. 152) notes examples of *Sigmodon hispidus* "supplied to the British Museum by Whitely from Veragua." As *Sigmodon borucæ,* Bangs (1902, p. 32) lists measured specimens taken by W. W. Brown, Jr., at Bugaba, which he says "appear to be identical with Allen's *S. borucæ* of Boruca, Costa Rica." Thomas (1903*a*, p. 41) records eight examples "mostly young," but probably referable to this form, from Cebaco Island off the southwestern coast of Panama. Anthony (1916, p. 368) records a specimen taken in a low grassy meadow near the Chagres River at Gatun.

Specimens from the Canal Zone are provisionally referred to this form, although the grayer examples are practically indistinguishable from typical *S. h. borucæ.*

Cotton rats are common only locally in the Canal Zone. At Gatun a few were captured in the thick grass growing in places where the forest has been cleared away. Such places are usually overgrown with grass and a few small bushes, with here and there clumps of larger bushes. The cotton rats make fairly well-trodden paths leading away, in various directions, from their holes which commonly enter the ground along low banks. At Tabernilla they are abundant in thick grass and small bushes which have overgrown earth and rock excavated from Culebra cut and dumped there several years ago.

Here, also, well-trodden paths, radiating from their holes off through the vegetation, were noted. The same local area is inhabited by *Zygodontomys cherriei ventriosus.* Both species avoid the heavy forest. Many cleared spaces where they were undoubtedly abundant have been inundated by the recent elevation of the level of Gatun Lake.

Specimens examined: Boqueron, 6[1]; Bugaba, 3[2]; Gatun, 7[3]; Tabernilla, 24.

SIGMODON AUSTERULUS Bangs

Chiriqui Cotton Rat

Sigmodon austerulus BANGS, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 32, April, 1902. Type from Volcan de Chiriqui, Chiriqui, Panama (altitude 10,000 feet).

The type, still unique, of *Sigmodon austerulus* was obtained by W. W. Brown, Jr., near the summit of the Volcan de Chiriqui.

The animal is well described as "about the size of *S. borucæ;* tail longer; pelage much more hispid; colors all much paler; skull similar." Quoted further the author says: "The one example from the top of the Volcan de Chiriqui, differs from *S. borucæ* of the adjacent low lands not only in having much more hispid pelage, a much paler coloration throughout, but also a longer tail.

"In the forest belt of the Volcan, where Mr. Brown did much trapping, he did not find *Sigmodon,* and for that reason I give full specific rank to the form of the summit of the Volcan de Chiriqui. It has been my experience that Sigmodons love open fields, savannahs, brushy places, and waste land, and avoid the dense forest."

Specimens examined: Volcan de Chiriqui, 1[2] (type).

Genus RHEOMYS Thomas. Water Mice

The single known species representing this genus in Panama is a small, dark-colored, aquatic mouse with short glossy fur. In general external appearance it suggests a musk rat in miniature. In the peculiar combination of cranial characters it differs widely from the other rodents of the region.

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[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Mus. Comp. Zool.
[3] One in collection Amer. Mus. Nat. Hist.

RHEOMYS RAPTOR Goldman

Panama Water Mouse

[Plate 23, figs. 1, 1*a*]

Rheomys raptor Goldman, Smiths. Misc. Coll., Vol. 60, No. 2, p. 7, September 20, 1912. Type from near head of Rio Limon, Mount Pirre, eastern Panama (altitude 4,500 feet).

Rheomys raptor is a small member of the group which includes *Ichthyomys hydrobates* and several rather aberrant genera of Murine rodents. They are largely aquatic in habits and some species are supposed to catch fish. In the present species there are short webs between some of the toes, and the fringing bristles, together with the character of the pelage, show fitness for an aquatic life. The upper incisors are of a more generalized Murine type than those of *Ichthyomys* which show specialization in form, the heavily beveled internal border resulting in a deeply emarginate cutting edge adapted for seizing and holding soft slippery prey.

The specimens of *R. raptor* were all captured in traps placed in the water among rocks and under logs in places where the water was oozing or trickling out over the banks of a small creek, one of the headwaters of the Rio Limon. There was no evidence that the species preys on fish, but small collections of freshly emptied shells of large water snails noted near the edge of the water in the vicinity suggested another probable food supply. The snails had evidently been gathered by some small predatory animal which had the power to break through the shells. The point chosen for attack was invariably the middle of the largest whorl, which when perforated exposed most of the snail's body. The holes in the shells were such as might readily be made by the incisors of *Rheomys*. Stomachs examined contained small quantities of pulp that may have been the remains of the bodies of snails.

Specimens examined: Mount Pirre (near head of Rio Limon), 3.

Subfamily MURINAE. Rats

Genus RATTUS Fischer. Common Rats

In the genus are included the common rats which are cosmopolitan, everywhere infesting the habitations of man, and many indigenous Old World species.

RATTUS RATTUS RATTUS (Linnæus)

Black Rat

[*Mus*] *rattus* LINNÆUS, Syst. Nat., Ed. 10, Vol. 1, p. 61, 1758. Type locality, Sweden.

The black rat is well established in the republic. Large numbers have been destroyed in the city of Panama as a sanitary measure, and in the vicinity of towns these rats have in places becomes naturalized in the open country.

At Empire one was trapped in a thicket along the edge of a corn field at least a quarter of a mile from the nearest house. On the small island of Buenaventura near Porto Bello the rats were very abundant and generally distributed through the woods.

Bangs (1901, p. 644) notes a specimen collected by W. W. Brown, Jr., on San Miguel Island. The species is recorded by Thomas (1903*a*, p. 40) from Brava and Cebaco, both small islands off the southwestern coast of the republic where specimens were taken by J. H. Batty for the British Museum. Allen (1904, p. 67) lists specimens obtained by J. H. Batty at Boqueron, where he states that this rat was "Very abundant, with the habits of a wild species, being found remote from towns or the dwellings of man."

Specimens examined: Boqueron, 17[1]; Boquete, 3[1]; Buenaventura Island (near Porto Bello), 1; Cana, 1; Empire, 1; Gatun, 1.

RATTUS RATTUS ALEXANDRINUS (Geoffroy)

Roof Rat

Mus alexandrinus GEOFFROY, Description de l'Egypte, mammiféres, 1818, p. 733. Type locality, Alexandria, Egypt.

The roof rat seems to be much rarer than the black form in Panama. A specimen collected by W. W. Brown, Jr., on San Miguel Island was recorded by Bangs (1901, p. 644) who says: "The three introduced species of *Mus* could not have been very numerous in San Miguel, as one individual of each was all that fell into Mr. Brown's traps in over three weeks of collecting."

Genus MUS Linnæus. House Mice

The genus *Mus* includes many indigenous Old World species and is represented in America by an immigrant, the familiar house mouse, now cosmopolitan in distribution.

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[1] Collection Amer. Mus. Nat. Hist.

MUS MUSCULUS MUSCULUS Linnæus

House Mouse

[*Mus*] *musculus* LINNÆUS, Syst. Nat., Ed. 10, Vol. 1, p. 62, 1758. Type locality, Sweden.

The only record I have of the occurrence of the house mouse in the republic is that of Bangs (1901, p. 644), based on a specimen taken by W. W. Brown, Jr., on San Miguel Island. The species probably inhabits the towns throughout most of the region.

In many localities these mice take to the fields where they seem to be able to exist under the same conditions, and in competition with native mammals. A dark Mexican form which has apparently developed differential characters has been described as subspecies *Mus musculus jalapæ*.

Family GEOMYIDAE. Pocket Gophers

A single genus of this family inhabits the region under review. The group, represented by other genera, reaches its greatest development farther north in Middle America, but at least one outlying species pushes northward into Canada.

Genus MACROGEOMYS Merriam

The members of this genus are robust burrowing animals, larger than large rats. They are very unlike any of the other mammals of the region and may be easily recognized by the very short ears which are reduced to mere folds in the skin, the deep external cheek pouches, the short, smooth, naked tail, and the large grooved upper incisors. The genus is now known to range from Nicaragua to extreme eastern Panama and probably enters Colombian territory.

MACROGEOMYS DARIENSIS Goldman

Darien Pocket Gopher; Dueño de Tierra; Chuchupa

[Plate 25, figs. 5, 5*a*]

Macrogeomys dariensis GOLDMAN, Smiths. Misc. Coll., Vol. 60, No. 2, pp. 8-10, September 20, 1912. Type from Cana, in the mountains of eastern Panama (altitude 2,000 feet).

The Darien pocket gopher is similar in general size to *M. cavator* of western Panama, but in color is a dull brown or black instead of the rich seal brown shade of the latter species. The skull is less massive, more elongated, narrower posteriorly, and differs in many important details; the lambdoid crest is low, nearly straight or slightly convex posteriorly instead of high and sinuous; the squa-

mosals are less extended laterally as postglenoid shelves, the margin being deeply notched and exposing much of the tubular portion of the bulla when viewed from above.

The home of one of these pocket gophers is a network of tunnels in the ground, along the lines of which large piles of earth are pushed out at irregular intervals. During the dry season few fresh workings are seen, but with the return of the rainy season their greater activity is shown by the numerous mounds of fresh earth excavated. They work mainly during the early morning and evening hours and at night. In the vicinity of Cana the pocket gophers are generally distributed over the forested slopes of the mountains up to about 2,500 feet altitude, but are most numerous in clearings, owing no doubt to the greater abundance of succulent roots and small plants available as food. Sugar-cane and banana fields on steep mountain slopes are especially favored. Banana and sugar-cane stalks are cut, and grass and other vegetation bitten off at the surface of the ground. Sugar-cane stalks are drawn gradually into the holes, the animal feeding at the basal end until nearly the whole is consumed. When one hole was opened a number of freshly cut grass stems—sections about three inches in length—were disclosed, all neatly piled at one side of the tunnel. Gophers also bore in ditch banks and are occasionally responsible for troublesome breaks in the ditches of the Darien Gold Mining Company. Gopher workings were noted at intervals along the railroad between the mines and the landing on the Tuyra River at Boca de Cupe. Specimens from the latter locality, where the altitude is about 250 feet, do not differ appreciably from those taken near Cana. The species therefore ranges from very low elevations upward over the basal slopes of the mountains in the Darien region. No traces of pocket gophers were seen in or near the Canal Zone, and there is no record of their occurrence in the central part of the republic. Native names at Boca de Cupe are "dueño de tierra" and "chuchupa."

Anthony (1916, p. 369) encountered the species at Boca de Cupe, Tacarcuna and Tapalisa, the two latter localities on the northern side of the Tuyra Valley. The highest workings noted by him were at about 4,200 feet.

Specimens examined: Boca de Cupe, 7[1]; Cana (type locality), 11; Tacarcuna, 5[2]; Tapalisa, 1.[2]

[1] Three in collection Amer. Mus. Nat. Hist.

[2] Collection Amer. Mus. Nat. Hist.

MACROGEOMYS CAVATOR Bangs.

Chiriqui Pocket Gopher

Macrogeomys cavator Bangs, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 42, text figs. 24-25, April, 1902. Type from Boquete, Chiriqui, Panama (altitude 4,800 feet).

The Chiriqui pocket gopher is based on a series of 26 specimens collected by W. W. Brown, Jr., at from 4,000 to 7,000 feet altitude in the vicinity of Boquete on the southern slope of the Volcan de Chiriqui.

The following is from the original description:

" Differs from the four known Costa Rican species, though nearest *M. dolichocephalus* Merriam. Compared with the type of that species, the skull is shorter and wider across zygoma; nasals, longer; distance from postorbital process to back of zygomatic arch, shorter; audital bullæ, flatter; sagittal and lambdoidal crests, heavier; zygomatic arch heavier and more angulated, standing widely and squarely out from skull. Color, very dark and nearly uniform—not pied as in the other species. Pelage, short, close and rather harsh.

" Upper parts dark seal-brown—almost black; under parts similar but slightly grizzled, the pelage sparse, so that the skin shows through; a small white anal patch, and sometimes small white patches under chin and on under side of wrists; whiskers colorless; feet, hands and tail, naked—in dried skin yellowish brown to dusky, the end of the tail black. In many specimens there are longer hairs scattered through the pelage, some of which are silvery, others brown like the general color of the back.

" This very distinct new species was abundant on the slopes of the volcano from 4,000 to 7,000 feet, but was not seen below 4,000 feet. It hardly needs comparison with any of the four previously known species from Costa Rica."

M. cavator seems to be somewhat larger and richer colored than *M. pansa* of the neighboring lowlands, but the two are evidently very closely allied and probably intergrade. The skulls of both differ notably from those of their known Costa Rican congeners in the high sinuous lambdoid crest, and in the greater anterior development of the basioccipital. *M. cavator* is similar in general size to the more recently described species, *M. dariensis* of eastern Panama, but the tail is shorter, the pelage longer and rich seal brown, instead of dull brown or black in color; the skull is less elongated, much broader posteriorly, and differs in many important details.

Additional specimens taken by J. H. Batty at the type locality of this species are recorded by Allen (1904, p. 70).

Specimens examined: Boquete, 24[1] (including type).

MACROGEOMYS PANSA Bangs

Bugaba Pocket Gopher

Macrogeomys pansa BANGS, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 44, April, 1902, text fig. 26. Type from Bugaba, Chiriqui, Panama (altitude 600 feet).

Eight specimens collected by W. W. Brown, Jr., at Bugaba are the basis of this foothill form which is evidently closely allied to *M. cavator,* the animal occurring at higher levels on the Volcan de Chiriqui. The close agreement of the two forms in the more essential characters suggests their probable intergradation on the lower slopes of the mountain.

The following forms part of the original description:

"Much smaller than the alpine, *M. cavator;* hind foot proportionally much larger (actually nearly the same size); colors duller and browner, more grayish white on belly; pelage short, close, very sparse on under parts, nose and sides of head and neck where the skin shows through. Skull much smaller and weaker throughout, with less spread to zygoma; nasals, shorter; interorbital width greater; molar-form teeth much smaller.

"Upper parts dull, dusky, chocolate-brown; under parts grizzled, the belly whitish: whiskers mostly colorless; feet, hands, and tail naked (in dried skin) yellowish brown, the tip of the tail dusky.

"In July, when Mr. Brown was at Bugaba, birds were moulting and mostly unfit for specimens; consequently he spent considerable time searching for suitable places for future work, trapping mammals, and collecting a few examples of some of the rarer birds. On one of his long rides he came upon a single isolated colony of pocket gophers. It was in the foot-hills, about 600 feet altitude, and was the only colony he found in the whole region. The members of this colony were rather hard to trap, as pocket gophers sometimes are, and unfortunately the only old ♂ secured was caught in the trap by the head and the skull crushed. The species is very different from the large, black species found so abundantly on the higher slopes of the Volcan de Chiriqui."

[1] Twenty-two in collection Mus. Comp. Zool.; two in Amer. Mus. Nat. Hist.

Contrasted with *M. dariensis* this species seems to be smaller. It is similar in the general character of its pelage, but differs otherwise in about the same characters as *M. cavator*.

Specimens examined: Bugaba, 6[1] (including type).

Family HETEROMYIDAE. Pocket Mice

The pocket mice are small rodents at once distinguishable by the deep external cheek pouches in combination with spiny or bristly pelage. In the character of the pelage they are not very unlike the Murine genus *Neacomys*, but the cheek pouches are distinctive. Two genera, *Heteromys* and *Liomys*, inhabit the region under review.

Subfamily HETEROMYINAE. Pocket Mice

Genus HETEROMYS Desmarest. Pocket Mice

Externally the pocket mice of this genus closely resemble those of the genus *Liomys*, but are more blackish, less grayish in the color of the upper parts, and the sole of the hind foot in the Panama forms is naked to the heel. The generic characters are exhibited by the skull, the dentition being more complex, the interpterygoid fossa V-shaped instead of U-shaped, and the angle of the mandible much less strongly everted than in the genus *Liomys*.

Subgenus HETEROMYS Desmarest

HETEROMYS AUSTRALIS CONSCIUS Goldman

Cana Pocket Mouse

[Plate 25, figs. 4, 4*a*]

Heteromys australis conscius GOLDMAN, Smiths. Misc. Coll., Vol. 60, No. 22, pp. 8-9, February 28, 1913. Type from Cana, eastern Panama (altitude 2,000 feet).

H. a. conscius is a small form of the genus, a rather slightly differentiated northern offshoot of the Ecuadorean species *H. australis*, which belongs to the *Heteromys anomalus* group. It is similar externally to some of the other forms of the region, but the cranial characters are distinctive. It is darker in general color than *H. a. australis*, and the slender hairs among the bristles on the back are grayer than in *H. a. lomitensis*, a closely allied Colombian form. The skull is more elongated, with broader ascending branches of premaxillae than that of *H. a. australis;* from that of *H. a. lomitensis* it differs in the broader upper surface of the maxillary arm of the

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[1] Collection Mus. Comp. Zool.

zygoma, and the broad posterior ends of the premaxillæ which are more nearly conterminous with the nasals; in *H. a. lomitensis* the nasals reach farther posteriorly.

This pocket mouse was taken mainly under logs in the forest at from 1,800 to 2,000 feet altitude on the lower slopes of the Pirre Range; the upper slopes, above 4,500 feet, are inhabited by the very different form, *H. desmarestianus crassirostris*.

Specimens examined: Cana, 5.

HETEROMYS DESMARESTIANUS REPENS Bangs

Chiriqui Spiny Pocket Mouse

Heteromys repens BANGS, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 45, April, 1902, text fig. 27. Type from Boquete, Chiriqui, Panama (altitude 4,000 feet).

Several apparently well-marked forms of the genus *Heteromys*, clearly referable to the *H. desmarestianus* group, have been described from Panama[1] as distinct species. The alleged species are based on collections from few localities, and while comparison of the various series reveals remarkably constant differences the differential characters suggest probable intergradation and the advisability of reducing these forms to subspecific rank. Their evolution, like that of other groups, appears to be largely a result of widely differing environmental conditions within restricted geographic areas.

The Chiriqui spiny pocket mouse is based on six specimens collected by W. W. Brown, Jr., on the southern slope of the lofty Volcan de Chiriqui. It is a dark-colored species similar to *H. desmarestianus desmarestianus* of Guatemala, but smaller and lacking the orange buffy lateral line of that species; it differs also in cranial details, the rostrum broadening more gradually to the zygomata, the nasals reaching posteriorly beyond the premaxillæ, and the molariform teeth smaller. Closer relationship is shown to *H. desmarestianus fuscatus* of Nicaragua, which is about the same in size, with a more blackish face, and differing in slight cranial details, the nasals and premaxillæ being more nearly conterminous posteriorly.

It is also similar to its nearer geographic neighbors in eastern Panama. From *H. desmarestianus zonalis* of the Canal Zone it is distinguished externally by the more ochraceous buffy suffusion of the upperparts. The skull differs in the greater posterior develop-

[1] *Heteromys fuscatus* Allen from Tuma, Nicaragua, may confidently be assigned to the same subspecific series and stand as *Heteromys desmarestianus fuscatus* Allen.

ment of the premaxillæ and in the more massive maxillary arm of the zygoma. Contrasted with *H. desmarestianus panamensis* it is somewhat paler in color and the fore feet are white instead of blackish; the skull differs in detail, the rostrum broadens less abruptly to the zygomata, the interparietal is narrower and the lateral wings of the supraoccipital are broader, more developed over mastoids.

A single specimen taken by J. H. Batty at Boqueron was recorded by Allen (1904, p. 70); the skull of this example exhibits the same shortening of the premaxillæ as compared with the nasals, and the interparietal is broad without a posterior emargination, but in the massive maxillary arm of the zygoma approaches that of *H. d. zonalis* and suggests intergradation with that subspecies.

Specimens examined: Boqueron, 1 [1]; Boquete, 7 [2] (including type).

HETEROMYS DESMARESTIANUS ZONALIS Goldman

Canal Zone Spiny Pocket Mouse

[Plate 25, figs. 3, 3*a*]

Heteromys zonalis Goldman, Smiths. Misc. Coll., Vol. 56, No. 36, p. 9, February 19, 1912. Type from Rio Indio, near Gatun, Canal Zone, Panama.

The Isthmian representative of the *H. desmarestianus* group is a rather large dark colored animal with the slender hairs inconspicuous among the bristles over the upperparts. Unlike *H. desmarestianus panamensis* and *H. desmarestianus crassirostris,* which have ankles dark all around, a white line extends along the inner side of the hind leg to the foot. Although so widely separated geographically this subspecies seems rather more like *H. desmarestianus desmarestianus* of Guatemala than like the allied forms in Panama. Compared with *H. d. desmarestianus* and *H. d. repens* the general color of the upperparts is darker, the slender hairs projecting beyond the bristles being less ochraceous buffy.

The Canal Zone pocket mouse inhabits the rocky slopes of low heavily forested hills near the Atlantic coast. Anthony (1916, p. 370) records the species from Maxon Ranch (Rio Trinidad).

Specimens examined: Gatun, 3; Maxon Ranch (Rio Trinidad), 1 [1]; Rio Indio (near Gatun), 1 (type).

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[1] Collection Amer. Mus. Nat. Hist.

[2] Six in collection Mus. Comp. Zool.; one in Amer. Mus. Nat. Hist.

HETEROMYS DESMARESTIANUS PANAMENSIS Goldman

Panama Spiny Pocket Mouse

[Plate 25, figs. 1, 1*a*]

Heteromys panamensis GOLDMAN, Smiths. Misc. Coll., Vol. 56, No. 36, p. 9, February 19, 1912. Type from Cerro Azul, near the headwaters of the Chagres River, Panama (altitude 2,800 feet).

The Panama spiny pocket mouse is similar to *Heteromys d. repens,* but still darker in color, the fore feet blackish instead of white to near the base of the toes. It is distinguished from its near geographic neighbor, *H. desmarestianus zonalis* of the Canal Zone, by the more ochraceous buffy suffusion of the upperparts, and the skull differs especially in the greater width of the interparietal and correspondingly reduced extent of the parietals along the supraoccipital border.

On the humid slopes of the mountains near the headwaters of the Chagres River this very dark spiny pocket mouse was found inhabiting the dense forest from 2,000 feet upward to the summit at about 3,000 feet altitude. It was also obtained at about 2,000 feet altitude on Cerro Brujo near the Atlantic coast. The specimens were all taken in traps placed on the ground under fallen logs or near crevices at the base of large trees.

Specimens examined: Cerro Azul (type locality), 5; Cerro Brujo, 1.

HETEROMYS DESMARESTIANUS CRASSIROSTRIS Goldman

Mount Pirre Spiny Pocket Mouse

[Plate 25, figs. 2, 2*a*]

Heteromys crassirostris GOLDMAN, Smiths. Misc. Coll., Vol. 60, No. 2, pp. 10-11, September 20, 1912. Type from near head of Rio Limon, Mount Pirre, eastern Panama (altitude 5,000 feet).

The discovery of this small spiny pocket mouse on Mount Pirre extends the known range of the *H. desmarestianus* group to near the eastern frontier of Panama, and it doubtless enters Colombian territory. It is similar to *H. desmarestianus panamensis,* but smaller; as in that form the ankles are dusky all around. The skull is remarkable for the unusual breadth of the rostrum.

The spiny pocket mice were evidently numerous at from 4,500 to about 5,000 feet altitude on the densely forested upper slopes of the mountains in the vicinity of the type locality. They were trapped in worn runways under logs where the moist surface is often fairly covered with small tracks and claw marks, and at holes in over-

hanging banks and in other sheltered places frequented by them while in search of food on the ground. Several were caught in traps set close to the palm-thatched camp; one was taken under my cot where it may have been attracted by some of the provisions. A pocket mouse held by the tail in a trap and still alive when removed set its teeth into clothing and tried to bite my hand. The rather dense undergrowth here consists largely of small palms and ferns. The only other small rodent which was found to occur in similar numbers in the same forest was another representative of a Middle American group, the Mount Pirre mouse, *Peromyscus pirrensis*. The lower slopes of the mountains at 2,000 feet are inhabited by *Heteromys australis conscius,* a form of a species mainly South American in distribution. The latter is similar to *H. d. crassirostris* in size and general external appearance, but the slender hairs among the blackish dorsal bristles are paler in color and the cranial characters indicate that the two forms of the genus which here occur so near together are specifically distinct. Anthony (1916, p. 370) records taking a specimen of *crassirostris* at 5,200 feet on Mount Tacarcuna.

Specimens examined: Mount Pirre, 23; Mount Tacarcuna, 1.[1]

Genus LIOMYS Merriam. Pocket Mice

The general color of the upperparts in the genus *Liomys* is more grayish, less blackish than in the genus *Heteromys,* and the sole of the hind foot is hairy from near the posterior tubercle to the heel (naked to heel in all Panama forms of *Heteromys*). Generic distinction is shown in the skull, the dentition being simpler, the interpterygoid fossa broadly U-shaped instead of V-shaped, and the angle of the mandible much more strongly everted.

LIOMYS ADSPERSUS (Peters)

Peters' Spiny Pocket Mouse

Heteromys adspersus PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 356, with pl., May, 1874. Type locality, City of Panama.[2]

In general external appearance Peters' spiny pocket mouse is not very unlike *Heteromys desmarestianus zonalis* which also inhabits the Canal Zone, but the upperparts are grayish instead of blackish; the tail is relatively shorter—about equal to or shorter than the head

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[1] Collection Amer. Mus. Nat. Hist.

[2] The species was originally described from "Panama," but the type in the Berlin Museum remained unique for nearly 40 years. In view of the rediscovery of the species in the suburbs of the City of Panama that place should be definitely chosen as the type locality.

and body; the sole of the hind foot is hairy from the posterior tubercle to the heel instead of naked to the heel as in all the species of *Heteromys* known to inhabit Panama.

The species as shown by specimens obtained by Messrs. Osgood and Anderson at Balboa for the Field Museum of Natural History, and by me at Empire, Canal Zone, is a large form of the *Liomys crispus* group which ranges thence northward through Middle America to southern Mexico. It has the same general coloration, proportionately short tail, and the dental peculiarities of the other members of the group. In color it approaches *Liomys heterothrix* of Honduras, but the slender tawny hairs which project beyond the dorsal bristles are less numerous. Moreover, it is characterized by larger size than that species.[1] Compared further, the skull has a relatively broader rostrum and the nasals and premaxillae are usually more nearly conterminous posteriorly than in *L. heterothrix*. The exact relationship of this form to the Costa Rican animal described by Thomas as *Heteromys salvini nigrescens* and currently recognized as *Liomys salvini nigrescens* remains to be determined.

Like other members of the *Liomys crispus* group *L. adspersus* inhabits dryer, less heavily forested areas than those usually favored by members of the genus *Heteromys*. It is probably restricted to the arid belt bordering the Pacific coast of Panama and replaced along the Atlantic side of the Isthmus by spiny pocket mice of the genus *Heteromys*. At Empire specimens were trapped among bushes, largely Compositae, along the border of a corn field. The pouches of one contained rolled oats used as bait, and some dead leaves cut in fragments about half an inch in length.

Specimens examined: Balboa, 3 [2]; Empire, 2.

Family OCTODONTIDAE. Octodonts

The Octodonts are rodents mainly South American and African in distribution. Of the several subfamilies usually recognized a single group, the Loncherinae, ranges within our limits.

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[1] A rather young female from Empire, Canal Zone, measures as follows: Total length, 245; tail vertebrae, 117; hind foot, 33.5. Skull (of same): Greatest length, 33.5; zygomatic breadth, 16; interorbital breadth, 7.5; nasals, 13.5; width of braincase (between outer sides of squamosals in front of auditory meatus), 14.4; alveolar length of upper molar series, 5.4.

[2] Collection Field Mus. Nat. Hist.

Subfamily LONCHERINAE. Spiny Rats

The subfamily includes three genera now known to enter Panama, *Diplomys, Proechimys* and *Hoplomys.* They are all rather large rat-like animals with grooved spines or bristles mingled with the hair, especially of the back.

Genus PROECHIMYS Allen. Spiny Rats

The genus *Proechimys* is similar to the genus *Hoplomys,* but the dorsal spines are much weaker. The ears are nearly naked as in that genus—not conspicuously tufted as in *Diplomys.* The long supra-orbital vibrissae of *Hoplomys* are replaced by short, inconspicuous hairs. The normally long tail, subject to accident as in *Hoplomys,* is thinly haired. The molariform teeth are cylindrical in form as in *Hoplomys*—not elongated antero-posteriorly as in *Diplomys.* As in the former genus the transverse grooves are shallow and through progressive wear and partial obliteration soon divide to form irregular enamel islands. The claws are long, nearly straight, and associated with terrestrial habits.

PROECHIMYS SEMISPINOSUS PANAMENSIS Thomas

Panama Spiny Rat; Macangué

Proechimys centralis panamensis THOMAS, Ann. Mag. Nat. Hist., Ser. 7, Vol. 5, p. 220, February, 1900. Type from Savanna of Panama (near city of Panama), Panama.

Proechimys centralis chiriquinus THOMAS, Ann. Mag. Nat. Hist., Ser. 7, Vol. 5, p. 220, February, 1900. Type from Bugaba, Chiriqui, Panama.

Two Panama forms of *Proechimys* were described by Mr. Oldfield Thomas as geographic races of *P. centralis* Thomas, of Nicaragua. Comparisons show that all of the known Middle American members of the genus differ slightly from each other and some of them are scarcely distinguishable from *P. semispinosus* Tomes, of Ecuador. In view of the evident close alliance the Middle American series may be assigned to that species,[1] unless it proves to be typified by an earlier described form. It is interesting to note, in this connection, that the Nicaragua animal was identified with Tomes' species by Dr. F. W. True[2] in 1889.

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[1] The forms should therefore stand subspecifically as follows:

Proechimys semispinosus semispinosus Tomes, Ecuador.
Proechimys semispinosus panamensis Thomas, City of Panama, Panama.
Proechimys semispinosus burrus Bangs, San Miguel Island, Panama.
Proechimys semispinosus rubellus Hollister, Pacuare, Costa Rica.
Proechimys semispinosus centralis Thomas, San Emilio, Nicaragua.

[2] Proc. U. S. Nat. Mus., Vol. 11 (1888) 1889, p. 467.

Proechimys s. panamensis differs from *P. s. semispinosus* in slightly paler coloration; the skulls are practically indistinguishable. *P. s. panamensis* compared with *P. s. centralis* is slightly richer, more ochraceous in color, the incisive foramina are more widely open, less pinched together posteriorly, and the inferior border of the jugal is less developed posteriorly to form a hook. The rich ochraceous coloration of *P. s. panamensis* is intensified in the insular form *P. s. burrus*. In general characters *P. s. panamensis* is about midway between *P. s. centralis* and *P. s. semispinosus*. *P. s. chiriquinus* seems to be inseparable from *P. s. panamensis*.

In Panama these spiny rats occur nearly everywhere, except on the slopes of the higher mountains. They appear to be terrestrial in habits and were taken by me in traps set usually under logs, projecting roots of trees, or among rocks in the forest. Two were caught on the top of the wall forming a part of one of the old forts on a hill near Porto Bello. The walls were overgrown with bushes, vines and small trees. Others were taken under logs in the edge of a clearing on the Setigantí River near Cana. Bangs (1902, p. 47) records 31 specimens from Divala and Bogava, Chiriqui, and further states that "though very common in the low lands and the foothills of the Volcan de Chiriqui the spiny rat certainly does not ascend the volcano to any great height as Mr. Brown did not find it at Boquete." Allen (1904, p. 70) lists specimens from Boqueron. Specimens in the British Museum are recorded by Thomas (1900*a*, p. 220; 1903*a*, p. 41) from Pacomé, Panama, and as *P. s. chiriquinus* from Governador, Brava and Cebaco, all islands off the southern coast of Chiriqui.

Anthony (1916, p. 370) reports this spiny rat "quite abundant" at low elevations in the Canal Zone and Tuyra Valley, less so at higher points and none were taken by the American Museum expedition on the crest of the range near Mount Tacarcuna. He lists specimens from Boca de Cupe, Cituro, Real de Santa Maria, Gatun, Maxon Ranch (Rio Trinidad), Tacarcuna (altitude 2,650 feet) and Tapalisa.

Tailless individuals are common on the Panama mainland and I noticed in skinning normal freshly killed specimens that the tail parts near the base on very slight strain, so slight, indeed, that in working rapidly care is necessary to avoid mutilating the skin which is easily broken at the same point. On examining museum material I find examples of *P. cayennensis*, *P. mincæ*, *P. canicollis* and of *Hoplomys gymnurus* that evidently had no tails when captured. Bangs is quoted on the tailless condition of *P. s. burrus* (p. 123) in

San Miguel Island; Allen and Chapman[1] are authorities for the following observations on *Proechimys trinitatis* of Trinidad:

"Three of the adults were entirely tailless, the loss of the tail having evidently occurred in early life, leaving only a broad cicatrix where the tail joined the body. . . . . The tendency in these animals to lose the tails renders an examination of the posterior portion of the vertebral column of the tailless examples a matter of interest. Fortunately this portion of the skeleton of two of the tailless specimens was preserved, and shows that the amputation occurs at the second vertebra behind the posterior border of the pelvis or just behind the fifth caudal. The four first caudals are normal in size and proportions, and appear to be in a healthy condition; the fifth caudal is abnormal, the posterior third or half having apparently been lost by absorption. A further interesting fact was noted in skinning the specimens in which the tail was still intact, namely, its easy separation at the fifth caudal vertebra, in several specimens the tail breaking at this point in the process of skinning. . . . . There are popularly supposed to be two species, one with and the other without a tail."

The present impaired condition near the base of the tail, and the absence of any evidence that tailless individuals fail to thrive, suggests that a progressive weakening of the part may ultimately produce a normally tailless group of animals.

At Boca de Cupe these spiny rats are eaten to some extent by the native population. The native name is "Macangué."

Specimens examined: Boca de Cupe, 7[2]; Boqueron, 14[3]; Bugaba, 19[4]; Cana, 7; Cituro, 4[3]; Divala, 11[4]; Empire, 2; Gatun, 21[3]; Maxon Ranch (Rio Trinidad), 3[4]; Real de Santa Maria, 8[3]; Rio Indio (near Gatun), 1; Tabernilla, 1; Tacarcuna, 3[3]; Tapalisa, 3.[3]

PROECHIMYS SEMISPINOSUS BURRUS Bangs

San Miguel Island Spiny Rat

Proechimys burrus Bangs, Amer. Nat., Vol. 35, p. 640, August, 1901. Type from San Miguel Island, Panama.

A richly colored insular representative of the widely ranging *P. semispinosus* group of spiny rats inhabits San Miguel Island, in the Bay of Panama. It differs from the neighboring mainland form, *P. s. panamensis,* mainly in somewhat richer reddish color. Mr.

[1] Bull. Amer. Mus. Nat. Hist., Vol. 5, pp. 225-227, 1893.
[2] Three in Amer. Mus. Nat. Hist.
[3] Collection Amer. Mus. Nat. Hist.
[4] Collection Mus. Comp. Zool.

Bangs in describing this form and recording 51 specimens collected by Mr. Brown remarks:

"The San Miguel spiny rat is a slightly differentiated island form of the *centralis* [*P. semispinosus*] series. It was very common in the island, and Mr. Brown easily took as many specimens as he wanted. It is known to the islanders as *raton mockungay*. They, however, believe the tailless individuals are a different animal. About one-third of the specimens taken were tailless. The animal was generally distributed throughout the island, and was often found living in the huts and sheds of the negroes, like the common rat."

Specimens examined: San Miguel Island, 43.[1]

Genus HOPLOMYS Allen. Spiny Rats

The genus *Hoplomys* may easily be recognized among the Octodont genera of Panama by the remarkably stout spiny armature. The blackish spines, nearly two millimeters in greatest breadth, project conspicuously beyond the softer element of the pelage over the back. The ears are nearly naked, instead of conspicuously tufted as in *Diplomys*. The supraorbital vibrissæ are very long, reaching posteriorly to the shoulders. The transverse grooves in the molariform teeth are shallow and their partial obliteration and the formation of enamel islands through wear beginning at an early age results in a complex crown pattern much as in *Proechimys*. Generic distinction rests on the more intricate enamel folds, especially of the last upper molar which has four principal grooves instead of three as in the latter genus. The claws are long, nearly straight, and indicate terrestrial habits. The long, nearly naked tail breaks readily close to the body, the stump heals over, and a tailless animal sometimes believed to be of a distinct species results.

HOPLOMYS GYMNURUS GOETHALSI Goldman

Goethals Spiny Rat

[Plate 26, figs. 2, 2*a*]

Hoplomys goethalsi GOLDMAN, Smiths. Misc. Coll., Vol. 56, No. 36, p. 10, February 19, 1912. Type from Rio Indio, near Gatun, Canal Zone, Panama.

The Isthmian representative of the genus externally resembles *Hoplomys gymnurus* Thomas and *Hoplomys truei* Allen. The heavy zygomata and other cranial characters are distinctive, but additional material obtained since the publication of the original description

[1] Forty-two in collection Mus. Comp. Zool.

indicates probable intergradation. Specimens from extreme eastern Panama show an approach to *H. gymnurus* in somewhat lighter zygomata and slightly smaller audital bullae. Geographic variation of relatively unimportant cranial details suggests the advisability of regarding the Middle American forms as subspecies of *Hoplomys gymnurus*.[1]

Like the species of *Proechimys* this spiny rat seems to be terrestrial in habits. Several examples were trapped under shelter of fallen trees and rocks in the forest. One was caught in a steel trap set on a narrow ledge under an overhanging river bank. Anthony (1916, p. 370) lists specimens from Gatun and the old village of Tacarcuna (2,650 feet).

Specimens examined: Cana, 5; Gatun, 2[2]; Rio Indio (type locality); Tacarcuna, 6.[2]

Genus DIPLOMYS Thomas. Spiny Rats

The spiny rats of the genus *Diplomys* are distinguishable from those of the other genera occurring in Panama by the short and conspicuously tufted ears, the blackish hairs projecting about half an inch beyond the margins. The face is marked by narrow vertical stripes at the posterior base of the whiskers. The dorsal pelage is bristly, but softer than in *Hoplomys* and *Proechimys*. The molariform teeth are more elongated antero-posteriorly, the crowns rectangular instead of cylindrical in general outline, and each divided until old age by three deep transverse furrows. The long tail is well haired. The short, broad hind feet, and short, strongly curved claws exhibit adaptation for an arboreal life.

DIPLOMYS LABILIS (Bangs)

Gliding Spiny Rat

Loncheres labilis Bangs, Amer. Nat., Vol. 35, p. 638, August, 1901. Type from San Miguel Island, Panama.

Concerning this insular species I can add little to Mr. Bangs' full original account. It was discovered by W. W. Brown, Jr., at the

[1] Pending further revision of the group the forms should therefore stand as follows:

Hoplomys gymnurus gymnurus Thomas, Cachavi, Ecuador.

Hoplomys gymnurus goethalsi Goldman, Rio Indio, near Gatun, Canal Zone.

Hoplomys gymnurus truei Allen, Lavala, Matagalpa, Nicaragua.

[2] Collection Amer. Mus. Nat. Hist.

time of his visit to San Miguel Island in the spring of 1900. From *D. darlingi* of the adjacent mainland it is distinguished at once by much more intense rufescent general coloration. The hind feet are rusty reddish instead of silvery white. Moreover, the skull is relatively narrower, more elongated, with smaller audital bullae.

Regarding the habits of the species Mr. Bangs remarks: "*Loncheres labilis* [=*Diplomys labilis*] was abundant in San Miguel Island, but was wholly arboreal, Mr. Brown catching all his specimens in traps set on the branches of large trees. It appears to be diurnal, and on one or two occasions Mr. Brown saw the animal proceeding along the branches with a curious gliding gait, his account suggesting the name I have used for the species. It is the 'Raton Marenero' of the islanders."

Specimens examined: San Miguel Island, 14.[1]

DIPLOMYS DARLINGI (Goldman)

Darling's Spiny Rat

[Plate 26, figs. 1, 1*a*]

Isothrix darlingi GOLDMAN, Smiths. Misc. Coll., Vol. 60, No. 2, pp. 12-13, September 20, 1912. Type from Marragantí (near Real de Santa Maria), on the Rio Tuyra, eastern Panama.

This species of *Diplomys* was first obtained by Dr. S. T. Darling, of the Sanitary Department, Isthmian Canal Commission, at Ancon, Canal Zone. No member of the genus had previously been taken on the Panama mainland, although an insular form described as *Loncheres labilis* Bangs had been discovered on San Miguel Island in the Bay of Panama. *D. darlingi* is much paler in color than *D. labilis,* the general tone of the upperparts being ochraceous buffy mixed with black, instead of the rich rufescent tint of *D. labilis.* The feet are silvery white instead of rusty reddish as in the latter species. The skull is relatively broader, the zygomata more spreading anteriorly and the audital bullae are larger. It may be not very unlike *Diplomys caniceps* (Gunther) from Medellin, Colombia, but the latter seems to be somewhat different in color, with a bushy tail, and the skull, as figured, differs in detail.

Of the habits of *D. darlingi* little is known except that it is an arboreal animal. The type specimen was seen one morning running up the trunk of a tree and was shot when it paused for a moment, partially hidden by the curvature of the trunk. The tree stood on the low forested bank of the Rio Tuyra where that stream meets the

[1] Thirteen in collection Mus. Comp. Zool.

tidewater of San Miguel Bay. The spiny rat climbed with the same facility a tree squirrel might have shown. Two specimens of this apparently rare species collected by W. B. Richardson at Tapalisa are recorded by Anthony (1916, p. 370). They were frightened from a hollow tree by the collector and shot while running along overhanging limbs from which they fell into the river. These adult examples are more rusty reddish on the back than the type specimen which was not fully grown.

Specimens examined: Ancon, 1; Marragantí (type locality), 1; Tapalisa, 2.[1]

Family DASYPROCTIDAE. Agoutis and Pacas

With the exception of the capybara (*Hydrochœrus*) the agoutis and pacas are the largest rodents inhabiting the region. The family includes three genera of which two, *Dasyprocta* and *Cuniculus,* range northward through Middle America to southern Mexico. They are terrestrial species with hoof-like claws, short ears and rudimentary tails. The other genus, *Myoprocta,* with a short but well-formed hairy external tail is restricted to South America.

Genus DASYPROCTA Illiger. Agoutis

The members of this genus, commonly referred to in literature as agoutis, are much more slenderly formed than the pacas of the genus *Cuniculus.* They have narrow, rabbit-like heads and the hind feet are provided with three instead of five toes as in the latter genus. The pelage of the rump is considerably elongated.

DASYPROCTA PUNCTATA ISTHMICA Alston

Isthmian Agouti; Ñequi

Dasyprocta isthmica Alston, Proc. Zool. Soc. London, 1876, p. 347. Type from Colon, Panama.

The agoutis or "ñequis" as they are called by the natives are common and well-known game animals of the region, much prized for the quality of their flesh as food. Several closely related forms of the *Dasyprocta punctata* group inhabit Middle America, ranging as a group as far north as southern Mexico, and southward into South America. *Dasyprocta punctata* was originally described from "South America," but according to Alston (1879, p. 172) the types collected during the voyage of the "Sulphur" by Commanders Belcher and Kellett are probably from the west coast of Costa Rica

[1] Collection Amer. Mus. Nat. Hist.

or Nicaragua. *D. punctata isthmica* of the Canal Zone and western Panama is distinguished externally from *D. punctata punctata* by less rich rufescent general coloration, and from *D. punctata dariensis,* its geographic neighbor on the east, by the more nearly uniform color of the back and rump. The elongated hairs of the rump are orange buffy like the back, instead of silvery gray or very pale buffy as in *D. p. dariensis* of eastern Panama.

In the Canal Zone the agoutis live in burrows, usually along steep banks or in rocky places. From the entrances well-beaten paths lead off a few yards through the forest undergrowth, or may connect holes at various points along the front of a ledge. In places their paths up the steep faces of cliffs have been used so long that they are worn deeply into the surface of rather soft sandstone. The agoutis are mainly nocturnal in habits and were shot at night in the forest where they were located by the reflection of their eyes in the field of light projected by a hunting lamp; but they may also be found abroad during the early morning and late evening hours, and in cloudy or rainy weather nearer the middle of the day.

One day while hunting near the Chagres River, a short distance below the mouth of the Rio Indio, I came to a low cliff and saw one of these animals run out of the bushes; it was scaling the rocks as I fired. It fell backward to the ground, and I found a well-worn agouti path leading up at this point. Erosion of the softer rock underneath had left the cliff overhanging near the base so that the animals were obliged to spring upward for about two and a half feet and then scramble up a nearly perpendicular rock on which there appeared to be practically no foothold. Another agouti was seen in a crevice among the rocks in the same vicinity.

Specimens from western Panama correctly referred to this form by Bangs (1902, p. 47) were collected by W. W. Brown, Jr., on the slope of the Volcan de Chiriqui and near Boquete. The other examples listed by Bangs from southwestern Panama represent specimens subsequently described as *D. p. nuchalis.*

Anthony (1916, p. 370) records a specimen collected by him at Maxon Ranch on the Rio Trinidad.

Specimens examined: Boquete, 2[1]; Gatun, 10; Maxon Ranch (Rio Trinidad), 1[2]; Rio Indio (near Gatun), 4.

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[1] Collection Mus. Comp. Zool.

[2] Collection Amer. Mus. Nat. Hist.

DASYPROCTA PUNCTATA DARIENSIS Goldman

Darien Agouti; Ñequi

[Plate 27, figs. 1, *1a*, *1b*]

Dasyprocta punctata dariensis GOLDMAN, Smiths. Misc. Coll., Vol. 60, No. 22, pp. 11-12, February 28, 1913. Type from near head of Rio Limon, Mount Pirre, eastern Panama (altitude 5,200 feet).

The Darien agouti replaces the Isthmian form of the *Dasyprocta punctata* group east of the Canal Zone where it has an altitudinal range from sea level on San Miguel Bay to over 5,000 feet on the summits of the Pirre Range near the Colombian frontier. Contrasted with *D. p. isthmica* of the Canal Zone, the Darien representative of the group is larger and darker in general color. The top of the head is blacker. The long hairs on the rump lack the basal annulations usually present in *D. p. isthmica,* and the tips of these hairs are very pale buff, silvery gray or whitish, in contrast with the orange buffy back; in *D. p. isthmica* the rump and back are more uniform in general tone. *D. p. dariensis* differs from *D. colombiana* of the Santa Marta region of Colombia, which is doubtless a form of the same group, in more buffy, less grayish coloration and in important cranial details, the rostrum being heavier and the anterior part of the jugal less extended vertically; in *D. colombiana* the jugal, more developed upward along the orbital border, approaches the lachrymal. It may be not very unlike *D. variegata* Tschudi, from Peru, but is very different from Tschudi's figure, and compared with an Ecuadorean specimen in the National Museum, assumed to be near *D. variegata,* is decidedly larger and darker colored. In the pallid coloration of the tips of the elongated hairs on the rump *D. p. dariensis* resembles *D. callida* of San Miguel Island, but the latter is a much grayer animal throughout.

Among the quaint accounts of animals encountered by Lionel Wafer (1729, p. 330) in eastern Panama during the summer of 1681 is one which apparently applies to the Darien agouti. He says:

"Here are *Rabbits,* called by our *English,* Indian Conies. They are as large as our Hares; But I know not that this Country has any Hares. These Rabbits have no Tails, and but little short Ears; and the Claws of their Feet are long. They lodge in the Roots of Trees, making no Burrows; and the *Indians* hunt them, but there is no great Plenty of them. They are very good Meat, and eat rather moister than ours." The statement in regard to burrows is, of course, erroneous.

Like the other forms of the group the Darien agouti is shy and apparently mainly nocturnal in habits; but if carefully searched for it may be found abroad early in the morning or late in the evening, and occasionally during the middle of the day, especially in wet weather. They become alarmed at the slightest noise and scamper away, often giving the characteristic squeak or short bark *eh-h—eh-h* from which the native name "ñequi" is derived. The usual method of hunting them is to proceed slowly and cautiously, mainly along trails through the forest, or wait in the vicinity of their holes until they come out. One day during the dry season, I heard a rustling noise in the dry leaves, and remaining motionless soon saw an agouti which came rapidly nearer and was shot as it stopped suddenly about 20 yards away. The Indians and native colored population hunt the agouti for its flesh and it is one of the favorite game animals of the region. As *Dasyprocta isthmica,* Anthony (1916, p. 370) records specimens from Boca de Cupe, Chepigana, Cituro and Real de Santa Maria.

Specimens examined: Aruza, 1; Boca de Cupe, 3[1]; Cana, 6; Chepigana, 2[1]; Cituro, 1[1]; Mount Pirre (type), 1; Real de Santa Maria, 2.[1]

DASYPROCTA PUNCTATA NUCHALIS Goldman

Black-naped Agouti

Dasyprocta punctata nuchalis Goldman, Proc. Biol. Soc. Washington, Vol. 30, p. 113, May 23, 1917. Type from Divala, Chiriqui, Panama.

The black-naped agouti inhabiting the comparatively arid lowlands near the Pacific coast of the southwestern part of the republic is a handsome subspecies easily distinguished from its geographic neighbors by the contrasting colors of the upper parts. The black nape, tawny back, and buffy rump present a color combination unusual in the group.

The specimens on which *D. p. nuchalis* is based were recorded by Bangs (1902, p. 47) as *Dasyprocta isthmica,* a form at that time very imperfectly known. The black-naped agouti may prove to have an extensive range along the Pacific coast of Panama and adjacent portions of southwestern Costa Rica. It is apparently replaced on the Volcan de Chiriqui, and probably along the Atlantic seaboard of western Panama, by *D. p. isthmica.*

Specimens examined: Bugaba, 2[2]; Divala, 3.[2]

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[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Mus. Comp. Zool.

DASYPROCTA CALLIDA Bangs

San Miguel Island Agouti

Dasyprocta callida Bangs, Amer. Nat., Vol. 35, p. 635, August, 1901. Type from San Miguel Island, Panama.

The San Miguel Island agouti is easily distinguished from the mainland forms of the group by its much paler coloration. It is most like *D. punctata dariensis* with which it agrees in the whitish tips and lack of basal annulations of the long hairs on the rump.

The species is based on a series of specimens taken by W. W. Brown, Jr., during a visit to the island in the spring of 1900. In connection with the original description Mr. Bangs details the collector's experience with the animal as follows: "The six specimens were all shot by Mr. Brown among mangroves, the leaves of which they are very fond of. The animal is much hunted by the negro pearl divers, and is exceedingly shy and wary, and for some time Mr. Brown was unable to secure one. One day during a storm he noticed that when a mangrove blew over it was at once stripped of its leaves by the agoutis. Acting upon a plan that this habit of the animal suggested to him, he took several large stones with him, and concealed himself in a tree. After a little he sent a stone crashing through the mangroves and presently saw an agouti cautiously approach the spot, thinking a mangrove had fallen over. The first day he shot two specimens in this way, and afterwards four more."

Specimens examined: San Miguel Island, 6.

DASYPROCTA COIBÆ Thomas

Coiba Island Agouti

Dasyprocta coibae Thomas, Novitat. Zoologicæ, Vol. 9, p. 136, April 10, 1902. Type from Coiba Island, Panama.

The Coiba Island agouti is very similar in color to *D. p. isthmica* and the rump hairs are rather distinctly barred to near base. But the skull is decidedly shorter, although similarly massive; the molariform teeth are smaller, the incisors shorter owing evidently to greater wear, the beveled surface reaching to near the alveoli in both jaws and suggesting feeding habits differing from those of the mainland forms; the audital bullæ are smaller and the basioccipital correspondingly broader.

In the original account the animal is described as agreeing with *Dasyprocta punctata punctata* in the annulation of the long hairs of the rump, but in the longer orange tips of these hairs and in the color of the body it is said to bear a closer resemblance to *D. p. isthmica.*

The species is based on five specimens collected by J. H. Batty in the spring of 1902. Four topotypes taken by the same collector and sent to the American Museum of Natural History are recorded by Allen (1904, p. 70) together with measurements of a larger series.

Specimens examined: Coiba Island, 6.[1]

Genus CUNICULUS Brisson. Pacas

The pacas are much more robust in form than the agoutis. The head is broader, the neck short and thick, and the limbs stouter. The toes of the hind feet are five instead of three in number. Another distinctive feature is the white-striped and spotted pelage. The broad head of the paca is due to the extraordinary expansion of the zygomatic arches which enclose a cavity lined with mucous membrane continuous with that of the mouth.

CUNICULUS PACA VIRGATUS (Bangs)

Panama Paca; Conejo Pintado

Agouti paca virgatus BANGS, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 47, April, 1902. Type from Divala, Chiriqui, Panama.

In allusion to its striped and spotted pelage the Panama paca is known to the natives as "conejo pintado." It differs from *C. paca paca* of South America in the encroachment of the white color of the underparts along the sides and the partial obliteration of dark stripes, a character which having proceeded still farther distinguishes the Mexican paca, *C. p. nelsoni,* from the present form.

Pacas are common in the Canal Zone and probably range in similar numbers throughout the forested parts of Panama. They live in burrows in the ground similar to those of agoutis. The burrows are often placed on steep slopes or in rocky places, but may enter soft soil where the ground is level. Like the agoutis they are mainly nocturnal in habits and may easily be located and shot by the reflection of their eyes in the light of a hunting lamp. They are often hunted with dogs and the skins being extremely tender many specimens obtained in this way are much lacerated. The thin, papery skin adheres tightly to the muscles and is also apt to be torn during the skinning process. Owing to the superior quality of their flesh the pacas are among the most important game animals of the region.

While hunting one day in the forest at 2,000 feet near Cana I saw a paca rush suddenly from a mass of leaves and small sticks a few feet away and disappear in the forest undergrowth. On examining the spot I found the animal had been resting in a cavity showing

[1] Collection Amer. Mus. Nat. Hist.

signs of regular use and where it was completely hidden until dislodged by my close approach. A burrow, evidently that of the paca, entered the ground at the base of a neighboring tree.

Specimens examined: Divala, 1[1] (type); Gatun, 8; Rio Indio (near Gatun), 7.

Family CAVIIDAE. Cavies and Capybaras

A single representative of this family, the capybara, until the present survey known only from South America, is among the more interesting mammals whose ranges are now found to extend into Panama.

Genus HYDROCHOERUS Brisson. Capybaras

As the largest existing rodents the capybaras, genus *Hydrochoerus*, are at once distinguished from the other members of the order. They are robust animals about three feet in length, the body thinly clothed with coarse hair. The webbed feet show adaptation for an aquatic life.

HYDROCHOERUS ISTHMIUS Goldman

Isthmian Capybara; Poncho

[Plate 28, figs. 1, 1*a*]

Hydrochoerus isthmius Goldman, Smiths. Misc. Coll., Vol. 60, No. 2, pp. 11-12, September 20, 1912. Type from Marraganti, near the head of tide-water on the Rio Tuyra, eastern Panama.

The capybara of Panama is decidedly smaller than *Hydrochoerus hydrochoeris* of northeastern South America and it differs in numerous important cranial details, especially the peculiar, short, thickened condition of the pterygoids.

On the Pacific coast of Panama it is apparently restricted to a limited area near the head of tidewater in the delta region of the Tuyra and Chucunaque rivers. A skull from "Atrato" collected by A. Schott, who accompanied Michler's expedition through the Darien region, seems referable to the same species which may therefore prove to have a wide range in the Atrato river valley. Anthony (1916, p. 371) records the species from El Real de Santa Maria.

At Marragantí many tracks were seen at low tide in early morning where the capybaras had crossed exposed mud banks between the water in the river and low-lying areas overgrown with tall swamp grass and other aquatic vegetation. *Capybaras* were found during the day occupying shallow beds hollowed in the ground, or wallowing in muddy pools, in secluded parts of the swamp. Sometimes they

[1] Collection Mus. Comp. Zool.

permitted me to approach quite near their hiding places and then rushing out in sudden alarm were shot as they crossed narrow open spaces. Their flesh, sometimes eaten by the natives, is not however considered very palatable. The native name of the animal is "poncho."

Specimens examined: Marragantí (type locality), 10.[1]

Family ERETHIZONTIDAE. Porcupines

The porcupines constitute a family of large rodents recognizable externally by the armament of long, stout, acute spines, which are especially well developed over the dorsal surface.

Subfamily ERETHIZONTINAE. American Porcupines

The subfamily Erethizontinæ includes two or three genera of American porcupines, all of which are arboreal in habits.

Genus COENDOU Lacépède

The porcupines of tropical Middle America, genus *Coendou,* are distinguished at once from the similarly spiny species of *Erethizon* inhabiting the northern woods, by the possession of a long, prehensile tail instead of a short brush. A further differential character of the tail, shared, however, with the Brazilian genus *Chætomys,* is that unlike most prehensile-tailed American mammals, the upper instead of the under side of the terminal portion of the member has become modified for direct contact in coiling about branches.

COENDOU MEXICANUM LAENATUM Thomas

Chiriqui Porcupine

Coendou laenatus Thomas, Ann. Mag. Nat. Hist., Ser. 7, Vol. 11, p. 381, April, 1903. Type from Boquete, Chiriqui, Panama.

The Chiriqui porcupine is the Isthmian representative of a densely furred Middle American group which ranges on the north to Mexico, the fur largely concealing the spines. In the other Panama species of the genus, *C. rothschildi,* the spines are fully exposed over the entire body. The type of *C. m. lænatum* is described as smaller, more heavily clothed, and with less inflated skull than *C. m. mexicanum.* Scanty material from Costa Rica and Honduras shows probable intergradation with the more northern forms of the group. Four porcupines collected by J. H. Batty at Boqueron, Chiriqui, and recorded by Allen (1904, p. 70), as *Coendou laenatus* prove to be

[1] Four in collection Amer. Mus. Nat. Hist.

referable to *Coendou rothschildi.* A specimen in the Museum of Comparative Zoology from Boquete was collected by H. J. Watson.

Specimens examined: Boquete, 1.[1]

COENDOU ROTHSCHILDI Thomas

Rothschild's Porcupine

Coendou rothschildi Thomas, Ann. Mag. Nat. Hist., Ser. 7, Vol. 10, p. 169, August, 1902 (see also Thomas, 1903a, p. 41). Type from Sevilla Island, off Chiriqui, Panama.

Rothschild's porcupine is readily distinguished from its Panama congener, *Coendou mexicanum laenatum,* by the exposed spiny covering, the spines in the latter species being mainly concealed by the long overlapping fur.

C. rothschildi, based on five examples from Sevilla Island and one from Brava Island, is a northern representative of a group mainly South American in distribution. The type is described as a spinous short-haired animal related to *C. quichua* Thomas of Ecuador.

The principal differential characters given are the profusely white-speckled back, and the rather larger skull with greater inflation above the orbits and larger nasal opening.

Specimens from Gatun and Rio Indio are provisionally referred to this species. They differ somewhat from the description of the type of *C. rothschildi* in the extent of the light basal color of the dorsal spines. This color reaches less than one-half, instead of three-fifths, the length of the spines, while the black subterminal band occupies one-half or more of the total length. In one individual the dorsal spines are black-tipped, the white tips being restricted to the forehead and sides where they are sparingly distributed.

In cranial characters these specimens conform closely with a series of ten from Boqueron, which are assumed to be typical, and four of which were erroneously recorded by Allen (1904, p. 70) as *C. lænatus.*

One of these porcupines, purchased from a native hunter at Gatun, had its stomach distended with vegetable matter massed in two colors; a greenish part apparently leaves, and a white mass which had the appearance of fruit pulp. The hunter reported locating two in a tree by the light of a hunting lamp, but while he was securing one the other escaped. In felling timber the animals are occasionally dislodged from places of concealment among matted vines in the tops of trees.

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[1] Collection in Mus. Comp. Zool.

Specimens examined: Boqueron, 10[1]; Gatun, 2; Rio Indio (near Gatun), 1; Tabernilla, 1.

Family SCIURIDAE. Squirrels

The family is represented in Panama by species of the familiar genus *Sciurus,* and by pygmy squirrels of the genera *Microsciurus* and *Syntheosciurus.* Like *Sciurus* the latter genera are arboreal in habits.

Genus SCIURUS Linnaeus. Tree Squirrels

The tree squirrels of the genus *Sciurus* inhabiting Panama are easily recognizable by larger size, when contrasted with the genera *Microsciurus* and *Syntheosciurus.* Generic distinction, however, is based mainly on dental characters. *Sciurus* differs from *Microsciurus* notably in the presence of small cusps intermediate in position between the larger tubercles on the outer side in the upper molariform teeth, and from *Syntheosciurus* in the absence of grooved upper incisors.

Subgenus SCIURUS Linnaeus

SCIURUS VARIEGATOIDES HELVEOLUS Goldman

Panama Squirrel

[Plate 29, figs. 2, 2*a*]

Sciurus variegatoides helveolus GOLDMAN, Smiths. Misc. Coll., Vol. 56, No. 36, p. 3, February 19, 1912. Type from Corozal, Canal Zone, Panama.

This large squirrel is amply distinguished from others inhabiting the region by the long black and white tail, the individual hairs of which are broadly tipped with the latter color. The limbs and underparts are paler than in the allied forms, *Sciurus variegatoides variegatoides* and *S. variegatoides dorsalis,* in the color phase with grizzled back. Its distribution area is the arid division lying along the Pacific coast from the vicinity of the city of Panama westward as far as Remedios where a specimen probably referable to this form has been recorded by Allen (1904, p. 66).

The squirrels of the *S. variegatoides* group are very imperfectly known. Several rather localized forms are recognized which in color present a remarkably wide range of individual variation. Large series of typical examplès are much needed to make clear many

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[1] Collection Amer. Mus. Nat. Hist.

doubtful points.[1] A specimen from Chorrera kindly loaned for examination by Dr. J. A. Allen of the American Museum of Natural History is like the Corozal specimens in color and agrees with them also in the absence of the small anterior premolar usually present in squirrels of this group. *S. v. helveolus* may intergrade with *S. v. melania* (Gray), a melanistic form described from Costa Rica and reported by Bangs (1902, p. 22) from various localities in Chiriqui.

Near Corozal in the middle of June the squirrels were found in mango trees in an old clearing about two miles east of the railroad station. Approaching the trees quietly I noted their rapid motions while cutting and feeding on the ripening fruit. They were not especially shy, but one that had been watching me suspiciously soon ran down a tree trunk and started rapidly off along the ground, carrying a large mango in its mouth. Five specimens collected by W. W. Brown, Jr., at Caledonia (near Panama) were recorded by Bangs (1906, p. 212) as *Sciurus adolphei dorsalis.*

Specimens examined: Calidonia, 5[2]; Corozal (type locality), 3; Chorrera, 1.

SCIURUS VARIEGATOIDES MELANIA (Gray)

Costa Rican Black Squirrel

Macroxus melania Gray, Ann. Mag. Nat. Hist., Ser. 3, Vol. 20, p. 425, 1867. Type from Point Burica, Costa Rica.

The black squirrel of Costa Rica, apparently a melanistic form, is recognizable at once by the unusual color. In fresh pelage it is nearly all black, the back only being of a dark chocolate shade which through wear fades to a yellowish brown color. Although differing widely in external appearance the animal is clearly related to *Sciurus variegatoides,* and its geographic position between *S. variegatoides dorsalis and S. variegatoides helveolus* suggests probable intergradation with both. Although intergradation has not been demonstrated, and black or chocolate brown appears to be the color of all the individuals occurring at various localities in Costa Rica and western

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[1] The material available indicates that the several known forms should stand subspecifically as follows:

Sciurus variegatoides variegatoides Ogilby, Salvador.
Sciurus variegatoides adolphei (Lesson) Realejo, Nicaragua.
Sciurus variegatoides dorsalis (Gray) Liberia, Costa Rica.
Sciurus variegatoides melania (Gray) Point Burica, Costa Rica.
Sciurus variegatoides helveolus Goldman, Corozal, Canal Zone, Panama.

[2] Collection Mus. Comp. Zool.

Panama, it seems best to treat it for the present as a subspecies of *S. variegatoides*.[1]

Sclater (1856, p. 139) evidently referred to this species in a list of mammals collected by Bridges in Chiriqui and published more than ten years before the original description of *Sciurus melania*, based on Costa Rican material, appeared. Regarding the squirrel, which was referred to the genus *Sciurus*, but the species unnamed, he says: "A black species, difficult to distinguish. Mr. Bridges states that it is common in the immediate vicinity of the town of David, and between that and the port of Boca Chica."

Twenty-one specimens, including adults and young of both sexes collected by W. W. Brown, Jr., at Divala, Bugaba, and Boquete were recorded by Bangs (1902, p. 22) who says: "It is a low-land species, and not found high up the Volcan de Chiriqui, 2,000 feet being the extreme altitude at which Mr. Brown saw it, and but once so high as that. About Bugaba (600 feet) and Divala, it is common and generally distributed in suitable places."

That this squirrel is not confined to the mainland is shown by Thomas (1903*a*, p. 40) who records specimens collected by J. H. Batty on Sevilla, Insoleta, Cebaco, and Brava, all small islands off the coast of the southwestern part of the republic. Ten specimens taken by the same collector at Boqueron for the American Museum of Natural History are recorded by Allen (1904, p. 66). The known general range of the animal is, therefore, the coastal plains and islands, and the basal mountain slopes on the Pacific side in western Panama and adjacent parts of Costa Rica.

Specimens examined: Bugaba, 5[2]; Boqueron, 17[3]; Boquete, 1[2]; Divala, 13.[2]

Subgenus GUERLINGUETUS Gray

SCIURUS HOFFMANNI CHIRIQUENSIS Bangs[4]

Chiriqui Squirrel

Sciurus (*Guerlinguetus*) *aestuans chiriquensis* BANGS, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 22, April, 1902. Type from Divala, Chiriqui, Panama.

Hoffmann's squirrel is somewhat similar to the subspecies of *Sciurus gerrardi* in general external appearance; the tail, however,

[1] For discussion of the status of this species see Nelson, Proc. Wash. Acad. Sci., Vol. 1, p. 74, 1899, and Bangs (1902, p. 22 and 1906, p. 212).

[2] Collection Mus. Comp. Zool.

[3] Collection Amer. Mus. Nat. Hist.

[4] Allen (1915, p. 212) in reviewing the South American squirrels has erected several new genera including *Mesosciurus*, with *Sciurus hoffmanni* as type. Some of these genera appear to be based on slight characters and I am not convinced of the desirability of such divisions.

is edged with ochraceous buff to the tip, instead of conspicuously tipped with black. The species, originally described from Costa Rica, ranges into western Panama where a form regarded as identical by Allen (1904, p. 66) and as distinct by him (1915, p. 220) has been described as *Sciurus æstuans chiriquensis* (Bangs, 1902, p. 22). As indicated by Allen (1915, p. 220) *S. h. chiriquensis* is distinguished by a slightly richer, more rufescent tone of coloration than typical *hoffmanni* of the Costa Rican highlands, a reversal of the differential characters as interpreted by Bangs in his original description. Dr. Allen also refers to *S. hoffmanni* specimens of a squirrel from the upper Cauca Valley, Colombia. The species was not encountered by me in the course of extensive work at low elevations in the Canal Zone and in the mountains of eastern Panama, and its range is apparently discontinuous in that region. It may, however, occur in the mountains along the Atlantic coast in an area from which I have seen no collections.

This is doubtless the species recorded from Panama under the name *Sciurus aestuans* by Sclater (1856, p. 139) who, referring to a specimen collected by Bridges, remarks: "This seems to agree with Bogota specimens so marked in the British Museum. It is from the Boqueti at the base of the volcano of Chiriqui." It was also regarded as *Sciurus aestuans* by Alston (1879, p. 132) who mentions British Museum material collected at Calovevora by Enrique Arcé. Forty-one specimens taken by W. W. Brown, Jr., at various localities including Divala, Bugaba, Boquete and the Volcan de Chiriqui at 7,500 feet are listed by Bangs (1902, p. 22). Mr. Bangs in his full account of the Chiriqui animal states that "skins from the Volcan de Chiriqui from upwards of 4,000 feet altitude are more woolly with decidedly more under fur than lowland examples, but otherwise they do not differ." Since Divala is near sea level on the Pacific coast this squirrel has a rather unusual altitudinal range. Fourteen specimens obtained by J. H. Batty for the American Museum of Natural History at Boqueron and Boquete were apparently the basis of Dr. Allen's reference of the Chiriqui form to typical *S. hoffmanni*. More recently (1915, p. 220) he assigns them together with examples from Divala, Bugaba, Tacoume, Cebaco Island, Sevilla Island, and Insolita Island to *S. h. chiriquensis*.

Specimens examined: Bugaba, 9[1]; Boqueron, 17[2]; Boquete, 17[3]; Divala (type locality), 14.[1]

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[1] Collection Mus. Comp. Zool.

[2] Collection Amer. Mus. Nat. Hist.

[3] Ten in collection Mus. Comp. Zool.; seven in Amer. Mus. Nat. Hist.

SCIURUS GERRARDI CHOCO Goldman

Darien Squirrel

[Plate 29, figs. 1, 1*a*]

Sciurus variabilis choco Goldman, Smiths. Misc. Coll., Vol. 60, No. 22, pp. 4-5, February 28, 1913. Type from Cana, eastern Panama (altitude 3,500 feet).

The *Sciurus gerrardi* group of tree squirrels, widely dispersed in northwestern South America is represented in Panama by two forms, one of which ranges as far north as the Canal Zone. They are recognizable by the varicolored tail, the intense rusty reddish general hue of which contrasts strongly with the broad black tip. In general shade of coloration they are not very unlike the smaller species, *S. hoffmanni,* which inhabits western Panama, but the latter has the tail uniformly washed or broadly edged with ochraceous buff to the tip.

S. g. choco of the Darien region in eastern Panama is closely allied to *S. g. morulus* of the Canal Zone, but is distinguished by darker color throughout; a deep black median dorsal stripe, usually continuous from near the shoulders posteriorly over the upper base of the tail, is absent or only faintly indicated in *S. g. morulus.* The underparts of the body are a darker rusty reddish shade; the under side of the tail is marked by a broader, more distinct black submarginal stripe. Variation from the usual rufescent coloration of the underparts is shown in one individual by limited areas of pure white near the armpits, on the pectoral and inguinal regions, and a very narrow stripe along the median line of the abdomen; in another the white is reduced to a few hairs near the armpits and on the sides of the lower part of the abdomen. These white areas may indicate gradation of this subspecies toward the South American forms of the *S. gerrardi* group in which the underparts are normally white. Specimens from 800 to 2,500 feet altitude, on Cerro Azul near the headwaters of the Chagres River, are somewhat intermediate between *S. g. morulus* and the Darien form, the black dorsal stripe being somewhat indistinct, but in the rich coloration of the underparts they agree with the latter form. *S. g. milleri* from the mountains of southwestern Colombia seems to be a nearly related form with the same pattern of coloration, but it differs in darker, more rusty reddish hue, the darkening due in part to the much narrower subterminal bands of the hairs on the shoulders and flanks.

These squirrels are generally distributed throughout the region visited, ranging upward in the forest from sea level in the Tuyra

Valley to over 5,000 feet altitude on the summits of the Pirre Range. They were usually seen springing through the branches from one tree to another. Occasionally they were found searching for food among the ferns, small palms, and other low ground cover, and on hearing me approach scrambled a few feet up a convenient tree trunk, where a pause was made, apparently to locate the cause of alarm. From such vantage points they sometimes continued upward into the tree top, at other times they turned downward again to the ground. Anthony (1916, p. 365) records specimens from Boca de Cupe, Chepigana, Cituro, Real de Santa Maria, Tacarcuna (2,650 to 5,200 feet) and Tapalisa.

Specimens examined: Cana (type locality), 5; Boca de Cupe, 5[1]; Cerro Azul, 3; Chepigana, 4[2]; Cituro, 6[2]; Marragantí, 3; Mount Pirre, 6; Real de Santa Maria, 7[2]; Tacarcuna (2,650-5,200 feet), 12[2]; Tapalisa, 2.[2]

SCIURUS GERRARDI MORULUS Bangs

Canal Zone Squirrel; Ardita

Sciurus variabilis morulus Bangs, Proc. New England Zool. Club, Vol. 2, p. 43, September 20, 1900. Type from Loma de Leon (Lion Hill), Panama.

The common squirrel of the Canal Zone, locally known as "ardita," is distinguished from *S. g. choco* of the Darien region by paler general coloration. The black median dorsal stripe usually present in the latter form is absent or only faintly indicated and the underparts are a paler rusty reddish shade. The bright rusty reddish instead of black and white tail is a recognition mark by which confusion of this form with *Sciurus variegatoides helveolus,* a larger squirrel of the region, may easily be avoided. *S. g. morulus* apparently intergrades with *S. g. choco* in the mountains near the headwaters of the Chagres River; the limits of its range west of the Canal Zone remain to be determined. Specimens from Obispo and Caimito (near Chorrera) were recorded by Alston (1879, p. 131) and from Gatun by Anthony (1916, p. 365).

This squirrel is one of the few rodents that are diurnal in habits and likely to be met with during a ramble in the forest. Owing to the density of the vegetation it may be passed unnoticed at a very short distance. In spite of bright colors it is not a very conspicuous object unless very near. Sometimes one was heard making a rasping noise as it gnawed the shells of hard fruits or nuts while

[1] Four in collection Amer. Mus. Nat. Hist.

[2] Collection Amer. Mus. Nat. Hist.

itself still invisible in the dense foliage. On approaching cautiously I usually found the squirrel sitting on a palm frond or the branch of a tree, 20 to 35 feet from the ground, its brilliantly colored tail curved over the back. At times they seemed rather indifferent and permitted me to come quite near; at other times they quickly took alarm and disappeared, usually running through the interlocking branches or leaping across intervening spaces from tree to tree instead of ascending a tall tree trunk. Occasionally they make their escape by running down a tree trunk and off along the ground. A few short, rather hoarse notes were heard from these squirrels, but they were usually silent. By the construction of the Gatun Dam the region of the type locality of *S. g. morulus* has nearly all been submerged, Lion Hill being now reduced to a tiny island in Gatun Lake.

Specimens examined: Lion Hill (type locality), 3; Gatun, 15[1]; Porto Bello, 1; Rio Indio (near Gatun), 6; Tabernilla, 2.

Genus **MICROSCIURUS** Allen. Pygmy Squirrels

The pygmy squirrels of the genus *Microsciurus* are mainly South American in distribution, but range northward through Panama to Costa Rica. *Microsciurus* is distinguished from *Sciurus* by diminutive size and the simpler molar cusp development already pointed out in the remarks on the latter genus, and from *Syntheosciurus* by the absence of grooved upper incisors.

MICROSCIURUS BOQUETENSIS Nelson

Chiriqui Pygmy Squirrel

Sciurus (*Microsciurus*) *boquetensis*, Nelson, Proc. Biol. Soc. Washington, Vol. 16, p. 121, September 30, 1903. Type from Boquete, Chiriqui, Panama (altitude 6,000 feet).

Several pygmy squirrels are now known to occur in Panama, from which this species is distinguished by the richer reddish coloration of the underparts. It is known only from the type locality on the slope of the Volcan de Chiriqui where specimens were collected for the British Museum by H. J. Watson.

In his recent revision of the genus Dr. Allen (1914, p. 152) regards *Microsciurus boquetensis* as "a strongly differentiated mountain form of the *alfari* group, with the soft fine pelage and strongly colored ventral surface of the *similis* group, in correlation with the altitude of its haunts. It seems entitled to rank as a species until its inter-

[1] Three in collection Amer. Mus. Nat. Hist.

gradation with other forms has been shown." As Dr. Allen remarks, specimens from Panama described by Alston (1878, p. 669) and referred by him to *Sciurus rufoniger* were doubtless some form of *Microsciurus*. These examples, collected by Enrique Arcé in western Panama, were later assigned by Alston (1879, p. 134) to *Sciurus chrysurus*. Arcé visited the Volcan de Chiriqui and Alston's description of the specimens applies fairly well to *Microsciurus boquetensis*. A specimen in the Museum of Comparative Zoology labelled "Panama, Gerrard, 1873," and probably collected by Arcé at Boquete seems clearly referable to this species.

Specimens examined: Boquete, 1 (topotype); "Panama" (probably Boquete), 1.

MICROSCIURUS ALFARI BROWNI Bangs

Brown's Pygmy Squirrel

Sciurus (Microsciurus) browni Bangs, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 24, April, 1902. Type from Bugaba, Chiriqui, Panama.

Brown's pygmy squirrel is paler in general color and the underparts are grayer than in the allied forms, *Microsciurus a. alfari* of Costa Rica and *Microsciurus a. venustulus* of the Canal Zone and eastern Panama. The tail is edged with grayish white instead of reddish as in *M. a. venustulus*.

This diminutive squirrel is known only from low elevations on the Pacific slope in the western part of the republic. Mr. Bangs in his original account of the animal says: "Mr. Brown [W. W. Brown, Jr.,] found this little squirrel in the forest about Bogaba [=Bugaba], at 600 feet altitude. It was rare and exceedingly hard to get, on account of its small size and dull coloring, and only by devoting much time and energy to the chase did he succeed in taking five specimens."

Specimens examined: Bugaba, 5.[1]

MICROSCIURUS ALFARI VENUSTULUS Goldman

Canal Zone Pygmy Squirrel

[Plate 30, figs. 2, 2*a*]

Microsciurus alfari venustulus Goldman, Smiths. Misc. Coll., Vol. 56, No. 36, p. 4, February 19, 1912. Type from Gatun, Canal Zone, Panama.

The Canal Zone representative of the *Microsciurus alfari* group of pygmy squirrels differs from *M. a. alfari* of Costa Rica in less rufescent general coloration, and from its closely allied geographic neighbor, *M. a. browni* of western Panama, in the darker tone of the

[1] Four in collection Mus. Comp. Zool.

upper and under parts. The tail is edged with rusty reddish instead of grayish white as in the latter form.

These tiny tree squirrels are apparently not very numerous, or, owing to the density of the forest cover they inhabit, individuals easily escape observation. In allusion to rapid movements the animal has received the native name, in the Canal Zone, of *ardita voladora*. One of the specimens taken at Gatun was seen running rapidly down the trunk of a tree. I noticed that the tail seemed to extend behind rather stiffly in a straight line with the body. On the top of the hill near the west end of the Gatun Dam one, which had evidently become alarmed at my approach, was seen moving down the trunk of a small tree. When within four feet of the ground it slipped suddenly out of sight on the opposite side before I could shoot. I supposed it had jumped to the ground but found on searching that it had climbed the tree again and was watching me from a perch among some leaves in the extreme top, sitting motionless with its tail curved over the back in characteristic squirrel fashion.

From the Canal Zone *M. a. venustulus* ranges eastward to near the Colombian frontier. A specimen collected at Porto Bello was clinging head downward, about 20 feet from the ground, on the trunk of a large tree giving short squeaking sounds suggesting those of some North American chipmunks. A single example was obtained at 2,000 feet altitude on the mountains near Cana. The same mountain slope at 3,500 feet is inhabited by *Microsciurus isthmius vivatus* which here typifies another species. Anthony (1916, p. 366), who obtained specimens on Mount Tacarcuna, also noted their occurrence in the same general locality and apparently overlapping the range of *M. i. vivatus*, but he states that *venustulus* was taken at slightly higher elevations and on the crest and eastern slope of the mountains. His specimens agree closely in color with the type. *M. i. venustulus*, contrasted with *M. i. vivatus* has darker, much more finely grizzled upperparts. Specific distinction is, however, better shown in cranial details; in the skull of *M. a. venustulus* the interpterygoid fossa and basioccipital are narrower, the maxillae are less extended at the expense of the frontals between the lachrymals and the premaxillae, and the interparietal is rectangular instead of subtriangular in outline. The type of *M. a. venustulus*, an adult female, lacks the small upper premolars usually present in *Microsciurus*.

Specimens examined: Gatun (type locality), 2; Cana, 1; Mount Tacarcuna, 3[1]; Porto Bello, 1.

[1] Collection Amer. Mus. Nat. Hist.

MICROSCIURUS ISTHMIUS VIVATUS Goldman

Mount Pirre Pygmy Squirrel

[Plate 30, figs. 1, 1*a*]

Microsciurus isthmius vivatus Goldman, Smiths. Misc. Coll., Vol. 60, No. 2, p. 4, September 20, 1912. Type from near Cana, eastern Panama (altitude 3,500 feet).

Comparatively little is known of the relationships of pygmy squirrels, most of the known forms being currently regarded as full species based on scant material from few localities. It was, therefore, with considerable interest that I noted the occurrence of two very distinct forms in close proximity on the Cana slope of the Pirre Mountains near the Colombian frontier. One of them proved to be *Microsciurus alfari venustulus,* previously known only from farther west, and the other an apparently new geographic race of *M. isthmius* whose general known range is in the valley of the Atrato River and the coast region of Colombia. Since *M. i. vivatus,* the new form, inhabits these mountains at 3,500 feet altitude, while *M. a. venustulus* was taken only 1,500 feet lower down on the steep slope, both will probably be found at the same elevations. *M. i. vivatus* is distinguished from *M. isthmius isthmius* by paler upperparts and orange buffy instead of deep ferruginous underparts. Anthony (1916, p. 366) records specimens of *M. i. vivatus* from 2,650 feet altitude near the village of Tacarcuna, which closely resemble specimens from the type locality, but have slightly richer-colored underparts. The examples of *M. i. vivatus* were obtained by me while hunting birds. They were all found among the lower branches or on the trunks of trees, where they were inconspicuous owing to masses of dense overhanging vegetation in the dimly lighted forest. In this forest, fog enshrouded during much of the time, one of these tiny squirrels moving along a tree trunk may easily be mistaken for one of the common Dendrocolaptine or Formicariinine birds of the region.

Specimens examined: Cana (type locality), 3; Mount Tacarcuna, 3.[1]

Genus SYNTHEOSCIURUS Bangs. Pygmy Squirrels

In this as yet monotypic genus of small tree squirrels an unusual departure in dental details is exhibited. The upper incisors are very slender and project outward and the outer surfaces, smooth in *Sciurus* and *Microsciurus,* each bear a longitudinal median groove.

[1] Collection Amer. Mus. Nat. Hist.

SYNTHEOSCIURUS BROCHUS Bangs

Groove-toothed Squirrel

Syntheosciurus brochus BANGS, Bull. Mus. Comp. Zool., Vol. 39, No. 2, p. 25, text figs. 1-4, April, 1902. Type from Boquete, Chiriqui, Panama (altitude 7,000 feet).

Concerning this peculiar squirrel nothing has been added to the full original account by Mr. Bangs. In general external appearance it is much like *Microsciurus,* but as the author states, is larger,[1] with "ear still smaller, hardly standing up above the fur, and very woolly; pelage very long, dense, and woolly. . . . . General coloration dark reddish olive, with under parts varying from orange rufous to ferruginous." Perhaps the most important as well as easily recognizable differential character is the grooved condition of the upper incisors.

Mr. Bangs further remarks: "Mr. Brown [W. W. Brown, Jr.] met with this remarkable squirrel but once, when he took the pair described. It was unknown to the native hunters who accompanied him, and who expressed much astonishment on being shown the two examples. Judging by the long, dense fur, even at this time of year—April 30—when the female was nursing young, it is evidently an animal of high elevations only.

"Among tree squirrels, *Syntheosciurus brochus* has no very near ally; its light, papery skull recalls that of *Sciuropterus,* but the audital bullae are much smaller. Its peculiarly straight, slender rostrum, weak, projecting, and grooved incisors at once distinguish the genus from any other."

Specimens examined: Boquete, 2 (including type).

Order LAGOMORPHA. Rabbits

Family LEPORIDAE.[2] Rabbits

The single genus *Sylvilagus* of the family Leporidae is known from Panama.

Genus SYLVILAGUS Gray

The only representative of this genus within the region under review is a forest rabbit of Middle America, easily distinguishable from its North American congeners by the short ears, dark color, and extremely short tail.

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[1] Type: Total length 320 mm. (total length in Microsciurus less than 300 mm.); tail vertebrae, 150; hind foot, 46.

[2] The family Leporidae, formerly placed by authors in the order Rodentia, has recently been elevated, along with the family Ochotonidae, to a group of full ordinal rank (see Gidley, Science, N. S., Vol. 36, pp. 285-287, August 30, 1912).

Subgenus TAPETI Gray

SYLVILAGUS GABBI GABBI (Allen)

Costa Rica Forest Rabbit

Lepus brasiliensis var *gabbi* Allen, Monogr. N. Amer. Rodentia, p. 349, August, 1877. Type from Talamanca, Costa Rica. (Probably near Sipurio, in the valley of the Rio Sicsola.)

Forest rabbits doubtless inhabit nearly the whole of Panama, and range from sea level well up on the slopes of the higher mountains. The Costa Rican form reaches from the western boundary as far east, at least, as the Canal Zone. In extreme eastern Panama it is replaced by a closely allied subspecies, *Sylvilagus g. messorius*, which is less rusty reddish in general color, and darker on the back.

While these rabbits may be met with in the depths of the forest, they favor the dense undergrowth along the edges of the forest, or old clearings. They are shy and apparently feed mainly at night, remaining during the day well concealed on forms under logs or other cover. Even when their hiding places have been discovered they may remain motionless, making no effort to escape until finally dislodged by the very close approach of an intruder when they scurry to the nearest shelter, perhaps only a few feet away. The very short tail is dark colored like the body and one misses the flash of contrasting white seen when a northern rabbit leaves cover.

Specimens from the localities on both the Atlantic and Pacific sides of the Canal Zone agree with the type of *S. g. gabbi* and are regarded as typical. Bangs (1902, p. 48) recorded specimens collected by W. W. Brown, Jr., as follows: "Nine specimens, Divala, November and December; Boquete, 3,400 to 4,500 feet, March and April, and Bugaba, July. The seasonal differences in color are well shown by this series. July specimens are much redder, with but few black-tipped hairs in the back, than autumnal examples." Six individuals taken by J. H. Batty have been recorded by Thomas (1903*a*, p. 42) from Gobernador Island, and rabbits probably occur on other islands near the coast of western Panama. Examples from Boqueron, also obtained by J. H. Batty, were listed by Allen (1904, p. 70).

Specimens examined: Boqueron, 5[1]; Boquete, 2[2]; Bugaba, 2[2]; Divala, 2[2]; Corozal, 1; Gatun, 7; Lion Hill, 2.[2]

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[1] Collection Amer. Mus. Nat. Hist.

[2] Collection Mus. Comp. Zool.

SYLVILAGUS GABBI MESSORIUS Goldman

Panama Forest Rabbit

[Plate 27, figs. 2, 2*a*]

Sylvilagus gabbi messorius GOLDMAN, Smiths. Misc. Coll., Vol. 60, No. 2, pp. 13-14, September 20, 1912. Type from Cana, eastern Panama (altitude 1,800 feet).

In the mountains of eastern Panama, *Sylvilagus gabbi gabbi* which ranges in western Panama and the Canal Zone is replaced by a closely allied subspecies lacking the strongly rufescent suffusion of color shown in the typical form, and with upperparts more obscured by the long black tips of the longer hairs. Anthony (1916, p. 371) lists specimens from Boca de Cupe, Tacarcuna, and Tapalisa and the darker form doubtless occurs throughout the general region, including adjacent Colombian territory.

In connection with the operation of the Darien gold mines considerable land on the small plateau near Cana has been cleared at different times and planted to sugar-cane and other crops. In these clearings, partly marshy and neglected for years, an exuberant growth of coarse grasses, shrubs, and small trees now form nearly impenetrable thickets in which the rabbits, as shown by their number, find conditions much more favorable for existence than in the unbroken forest. In places, well-trodden paths mark their general routes through dense cover. During the dry season small areas are sometimes burned over and the fresh new verdure springing up affords an attractive food supply. The rabbits visit these open spaces to feed at night and are easily shot, their eyes giving off reddish reflections in the glare of a hunting lamp. In the field of reflected light they sit motionless and if no noise is made one may approach to within a few feet, before they take alarm and dash off into the darkness.

Specimens examined: Boca de Cupe, 3[1]; Cana (type locality), 10; Tacarcuna, 2[1]; Tapalisa, 4.[1]

SYLVILAGUS GABBI INCITATUS (Bangs)

San Miguel Island Rabbit

Lepus (*Tapeti*) *incitatus* BANGS, Amer. Nat., Vol. 35, p. 633, August 22, 1901. Type from San Miguel Island, Panama.

Greater general dimensions combined with shorter ears and paler color apparently distinguish this insular form from *Sylvilagus gabbi*

[1] Collection Amer. Mus. Nat. Hist.

gabbi of the adjacent mainland. The braincase is also narrower, and the rostral portion of the skull heavier than usual in the group. The animal was one of those discovered by W. W. Brown, Jr., during his collecting trip to San Miguel Island for Mr. Bangs in the spring of 1900.

Regarding its occurrence, Mr. Bangs in his original account says: "The hare was not at all common in San Miguel Island, and Mr. Brown saw but one other during his stay. Mr. Brown tells me that *Lepus gabbi* and *L. incitatus* [=*Sylvilagus gabbi incitatus*] are extraordinarily swift of foot and are seldom seen except for an instant as they dart like a flash through the undergrowth."

Specimens examined: The type and only known example.

SYLVILAGUS GABBI CONSOBRINUS Anthony

Savanna Rabbit

Sylvilagus gabbi consobrinus Anthony, Bull. Amer. Mus. Nat. Hist., Vol. 37, p. 335, May 28, 1917. Type from Old Panama (near City of Panama), Panama.

An unusually light-colored rabbit taken by Mr. H. E. Anthony near the savanna at Old Panama on the Shiras Expedition of 1914 was recorded by him (1916, p. 371) as *Sylvilagus gabbi gabbi*. More recently this specimen has been described by him and made the type of *Sylvilagus gabbi consobrinus*, an apparently pale form which may range at low elevations throughout the savanna regions of southern Panama. The few specimens of *Sylvilagus* available from Boqueron, Bugaba, and Divala appear somewhat intermediate in color between typical *S. g. gabbi* and the type of *S. g. consobrinus*, and might with similar propriety be referred to either subspecies. They are listed as *S. g. gabbi*, but future increments of material from the general region may indicate the desirability of transferring them to the paler form.

Specimens examined: The type.

Order CARNIVORA. Carnivores

Family CANIDAE. Wolves, Foxes, Bush Dogs

None of the familiar North American members of the family to which our domestic dog belongs are known from the region under consideration. The single genus occurring represents the intrusive South American element of the fauna.

Genus ICTICYON Lund. Bush Dogs

The somewhat aberrant genus *Icticyon* was not until the present survey known to enter Panama. It is a robust animal with short ears, limbs, and tail and at first glance is scarcely recognized as a member of the Canine family. The general proportions and long hair give the bush dog a badger-like appearance.

ICTICYON PANAMENSIS Goldman

Panama Bush Dog

[Plate 31, figs. 1, 1*a*]

Icticyon panamensis GOLDMAN, Smiths. Misc. Coll., Vol. 60, No. 2, pp. 14-15, September 20, 1912. Type from near head of Rio Limon, Mount Pirre, eastern Panama (altitude 5,000 feet).

One afternoon while in camp near the summit of Mount Pirre several short dog-like barks were heard not far away. Cautiously stalking in that direction I saw the whitish shoulders of an old female bush dog suddenly appear through a small opening, presenting a conspicuous target in the dimly lighted forest. A quick shot brought her down. Three nearly full-grown young were soon sighted, two of which were secured while the other escaped. Tracks led to a burrow a few yards away on a steep hillside covered with tall forest. Fresh earth had been thrown out of a tunnel directed downward at an angle of about 45 degrees. The ground was trampled and the place showed other signs of habitation for a considerable period. Many bones and fragments scattered about the entrance to the burrow had been carried from a heap of camp refuse; the bush dogs had evidently been our very near neighbors for two weeks before the barking, probably of the young, led to detection.

The discovery of a bush dog in Panama materially extends the known range of the genus northward. The Panama animal apparently differs from *Icticyon venaticus* of Brazil in the whitish color of the anterior part of the body and in cranial details.

Specimens examined: Three, an old female (the type) and her offspring, two nearly full-grown young, from Mount Pirre.

Family PROCYONIDAE. Raccoons, Cacomistles, Coatis, and Kinkajous, etc.

The family includes the familiar "coon," the less familiar "cacomistle," representatives of which reach the United States, the rare *Bassaricyon,* and the common coatis and kinkajous of the American

tropics. They are all medium-sized carnivores with plantigrade feet, naked soles, and curved non-retractile claws. The tail is moderately long, somewhat bushy, and usually more or less distinctly annulated.

Genus **BASSARISCUS** Coues. Cacomistles

The cacomistles are more slender in form than the related genera of the region. They have short, rounded heads with larger ears than *Potos* or *Bassaricyon*. The tail, flattened and long-haired to the tip like that of *Bassaricyon*, is ringed in strongly contrasting colors throughout its length.

BASSARISCUS SUMICHRASTI NOTINUS Thomas

Panama Bassariscus; Cacomistle

Bassariscus sumichrasti notinus Thomas, Ann. Mag. Nat. Hist., Ser. 7, Vol. 11, p. 379, April, 1903. Type from Boquete, Chiriqui, Panama (altitude 6,000 feet).

The only record of the occurrence of *Bassariscus* in Panama seems to be that of the type of *B. s. notinus,* from Boquete, at 6,000 feet altitude on the southern slope of the Volcan de Chiriqui. It is described as paler in color, with smaller skull and teeth, and longer palate in contrast with *B. s. variabilis* of Guatemala.

The various forms of the genus *Bassariscus* are all slender, short-legged animals, grayish in general color and with fox-like faces. Perhaps the most distinctive external character, however, is the tail which is about as long or longer than the body, with alternate black and white or gray rings. The general range of the genus *Bassariscus* is to the northward, one form reaching Oregon. Except in parts of Mexico where *B. astutus* is very common these animals are rather scarce, or of local occurrence only, and owing to retiring habits are little known. All of the forms are expert climbers. *B. astutus* commonly lives in caves or crevices in cliffs, but the forms of the more southern species, *B. sumichrasti,* seem to be more arboreal in habits. *B. sumichrasti* also differs notably from *B. astutus* in the longer tail, the more extensively naked soles of feet, and in dental details, the cutting edges of the first and second upper incisors of the permanent series being finely but distinctly trifid, while in the latter species they are smooth. In very young examples of *B. astutus,* however, a tendency to similar division of the edges in these teeth is sometimes shown. The Mexicans use the native name *cacomistle,* but no English vernacular name for animals of this group has met with general acceptance.

Genus **PROCYON** Storr. Raccoons

The raccoons are distinguished externally by robust form, short ears and nose, and rather short, somewhat bushy, ringed tail. Two species, recognized as subgenerically distinct, inhabit parts of the Isthmian region.

Subgenus **PROCYON** Storr

PROCYON LOTOR PUMILUS Miller

Little Panama Raccoon; Mapachin

[Plate 32, figs. 1, 1*a*]

Procyon pumilus Miller, Proc. Biol. Soc. Washington, Vol. 24, p. 3, January 28, 1911. Type from Ancon, Panama.

The mapachin or common raccoon closely resembles its congener, the crab-eating species, but is recognizable externally by the normal inclination backward of the pelage of the nape.

Material now available, including a series of six topotypes, shows that this raccoon, while small, is not so diminutive as the type, a rather unusually under-sized and not fully adult individual, seemed to indicate. General comparisons point to intergradation with the common raccoon of North America, through *Procyon lotor crassidens* of Costa Rica, the next geographic race to the north, and *P. l. hernandezii* of Mexico. The animal inhabiting the Canal Zone, and differing essentially from the more northern continental forms only in size, marks in this region the southern known limit of the range of the *P. lotor* group.

These raccoons are more numerous in the Canal Zone than the larger so-called crab-eating species, *Procyon cancrivorus panamensis,* which inhabits the same region. While generally distributed they favor the vicinity of swamps and streams and share the crab-eating habit with *P. c. panamensis,* as shown by stomachs examined. They are more arboreal in habits, however, as evidenced by their sharper claws and the fact that they were commonly found in trees while the latter species was encountered on the ground. Several were shot at night as they climbed about among the mangroves along the Moré River near Porto Bello. They were located by their eyes which give off deep red reflections under the glare of a hunting lamp. On one occasion two were found close together in a tree, and when shot both at once came tumbling with a great splash into the water near the canoe.

Bangs (1902, p. 49) notes the species from Pedregal, Chiriqui, where it was taken by W. W. Brown, Jr. Allen (1904, p. 77) recorded a specimen taken by J. H. Batty at Boqueron.

Specimens examined: Balboa, 6[1]; Boqueron, 1[2]; Gatun, 4; Pedregal, 1[3]; Porto Bello, 2.

Subgenus EUPROCYON Gray

PROCYON CANCRIVORUS PANAMENSIS (Goldman)

Panama Crab-eating Raccoon: Mapachin

[Plate 33, figs. 1, 1*a*]

Euprocyon cancrivorus panamensis GOLDMAN, Smiths. Misc. Coll., Vol. 60, No. 22, pp. 15-16, February 28, 1913. Type from Gatun, Canal Zone, Panama.

The Panama crab-eating raccoon differs from its North American relative, of the subgenus *Procyon,* in the reversed direction of the pelage of the nape; from a hair-whorl between the shoulders the pelage is inclined forward, meeting the opposing pelage of the head along a V-shaped line between the ears. It differs also in cranial and dental characters, especially the more rounded molariform cusps which are better adapted for crushing hard substances. The general non-sectorial character of the dentition is shown in the upper carnassial where the trenchant commissure of the median outer cusp and the postero-internal cusp present in the more northern species is absent.

The crab-eating raccoon is mainly South American in distribution, but is represented as far north as the Canal Zone where it meets the range of a southern form of the *Procyon lotor* group. In Panama the altitudinal range is from sea level to 2,000 feet, as determined by the capture of a specimen near Cana, on the slope of the Pirre Mountains.

Several were shot at night along the banks of the Chagres River, their eyes appearing deep red under the light of a hunting lamp. Another specimen obtained was killed as it emerged from some tall grass near the edge of a swamp whence it had been driven by a pack of hounds. Stomachs examined contained fragments of fish and crabs.

The so-called crab-eating raccoon is apparently less arboreal in habits than *Procyon lotor,* the Panama representative of which is, however, also a crab eater. Adaptation for a terrestrial life is shown in the bluntness of the claws as compared with those of *Procyon.* All of the specimens obtained were found upon the ground while those of *Procyon* were usually located in trees.

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[1] Collection Field Mus. Nat. Hist.

[2] Collection Amer. Mus. Nat. Hist.

[3] Collection Mus. Comp. Zool.

The species was noted from as far north as Colon by Sclater (1875, p. 421). Alston (1879, p. 69) probably referred to the same material as Sclater in stating that "The Crab-eating Raccoon is found as far north as Panama, whence living specimens have more than once been received by the Zoological Society, and Veragua, whence it has been obtained by M. Boucard."

The native name *mapachin* is also applied to *Procyon lotor pumilus*.

Specimens examined: Cana, 1; Gatun, 3; Panama, 1[1]; Porto Bello, 1.

Genus NASUA Storr. Coatis

The coatis are remarkable for the length and mobility of the snout which projects forward well beyond the lower lip. The claws are long and rather straight and blunt for such arboreal animals. The ears are short and the tail long and tapering. The muzzle is whitish or grayish, and two narrow whitish lines usually extend backward along the face diverging gradually to enclose the eyes.

NASUA NARICA PANAMENSIS Allen

Panama Coati; Pisote

Nasua narica panamensis ALLEN, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 51, February 29, 1904. Type from Boqueron, Chiriqui, Panama.

The long projecting snout of the coati fully distinguishes it from the other members of the general group to which it belongs.

Nasua narica, represented by several closely allied continental forms, ranges throughout the tropical portions of Middle America and ascends from sea level well up on the slopes of the higher mountains. Variation in color and cranial details is remarkable and to *N. n. panamensis* I provisionally refer the animal inhabiting the region as far east as Cana. The material available is insufficient to satisfactorily determine the exact status and relationships of this subspecies, but it seems doubtfully recognizable from *N. n. bullata* of Costa Rica.

Dr. Allen (*l. c.*) in describing the Panama form says that in coloration it is "not readily distinguishable from *N. narica bullata,* being very dark and highly colored, but much smaller, and with the bullae of the usual size for the *narica* group." He adds: "*N. narica panamensis* probably differs very little in average coloration from *N. n. bullata,* both forms presenting the usual wide individual range of color-variation seen in all the forms of *Nasua,* but it

[1] Collection Mus. Comp. Zool.

is apparently very much smaller, with the audital bullae nearly one-half less. From *N. narica* it differs markedly through its much darker general coloration, and still more so in this respect from the forms of the more arid portions of Mexico."

The coatis are largely arboreal in habits, but they appear to be equally at home upon the ground. They are sociable animals and commonly range about in parties or troops consisting of several old females and younger animals of both sexes. The old males are met with alone, and from their solitary habits are in many localities supposed to be of a different species. They are referred to in Panama as *pisote solo* to distinguish them from the more gregarious *pisote de manada*. Under other native names the same distinction is made in other parts of Middle America.

The coatis are less strictly nocturnal in their activity than some of the other members of the family. At Gatun several parties of from five or six to a dozen individuals were seen roaming through the forest during the morning and evening hours. During the heat of the day they were occasionally startled from a resting place in the trees, from which they tried to escape by running along large branches and passing across into other trees, or came bounding down and off along the ground. When searching for food they carry their long tails high in the air and move at a rather rapid pace, running here and there, pausing a moment to paw up the ground or poke their long noses into likely places and then hurrying on to overtake more advanced members of the troop. They also ascend trees in quest of food. Stomachs examined by me contained fruit pulp only, but they probably have a diversified diet.

Belt[1] in Nicaragua observed a solitary pisote climb trees in pursuit of iguanas, the large tree lizards of the region, but they made their escape by dropping to the ground and rushing off to another tree. The pisote, "however, seemed to take all his disappointments with the greatest coolness, and continued the pursuit unflaggingly. Doubtless experience had taught him that his perserverance would ultimately be rewarded; that sooner or later he would surprise a corpulent iguana fast asleep on some branch, and too late to drop from his resting-place." In Panama the iguanas congregate in numbers to feed on the flowers of certain trees, especially an *Erythrina*-like species at Gatun; at such times some of them would not be likely to escape the sudden attack of a party of pisotes.

[1] The Naturalist in Nicaragua, p. 339, 1888.

They are easily tamed and make entertaining pets. Their sense of smell is keen as shown by one at Gatun that without offering to bite would force his long snout into the spaces between my fingers in order to reach a nut held in my clenched hand; but if I extended my empty hand, clenched as before, he merely sniffed at it. When hunted with dogs a whole party will quickly climb trees and pass across from one tree to another until they reach a point where they can go no farther in that direction. If one or more are shot the others usually attempt to escape by running down the tree trunks; reaching the earth with a bound, they frequently avoid the waiting dogs and go scampering off to another tree. If caught by the dogs, they fight savagely, and slashing with their long, sharp tusks, often inflict serious wounds.

Alston (1879, p. 75) notes the species as collected by M. Boucard in Panama. Under the name *Nasua narica* specimens collected at Boquete by W. W. Brown, Jr., were listed by Bangs (1902, p. 49) who says: "The nasuas separate naturally into many geographic races. These, as proper material accumulates, are gradually coming to be understood; the name *narica* is used here provisionally." These specimens were referred to *N. n. panamensis* by Allen (1904, p. 77) who says of them "while they agree in color with *bullata*, they lack the excessive development of the audital bullæ seen in that form." All of the specimens from Panama are provisionally referred to *N. n. panamensis*, but the audital bullæ are very variable in size, in some examples closely approaching those of *N. n. bullata*, and *N. n. panamensis* may prove to be based on an unstable character. Anthony (1916, p. 372) lists specimens from Boca de Cupe; Real de Santa Maria, Tacarcuna and Tapalisa.

Specimens examined: Boca de Cupe, 1[1]; Boquete, 6[2]; Boqueron, 1[1]; Cana, 1; Gatun, 2; Real de Santa Maria, 1[1]; Tacarcuna, 2[1]; Tapalisa, 4[1]; Volcan de Chiriqui, 1.

Genus BASSARICYON Allen

In external appearance *Bassaricyon* closely resembles *Potos*, the short ears, short face, rounded head and general proportions being about the same. The tail, however, unlike that of *Potos*, is non-prehensile, somewhat flattened like that of a squirrel, and instead of tapering is long-haired to the tip. In cranial characters *Bassaricyon* and *Potos* are widely different. The known range of the genus is

[1] Collection Amer. Mus. Nat. Hist.

[2] Collection Mus. Comp. Zool.

from Ecuador to Nicaragua, and in Panama it ascends from sea level to 5,000 feet altitude. Two closely allied forms occur within our limits.

BASSARICYON GABBII GABBII Allen

Bushy-tailed Olingo

[*Bassaricyon*] *gabbii* ALLEN, Proc. Acad. Nat. Sci., Philadelphia, p. 23, April 18, 1876. Type from Talamanca, Costa Rica.

The known forms of the genus agree closely in essential characters and may prove to be geographic races all assignable subspecifically to *Bassaricyon gabbii.* The distinguishing characteristics of the species are the same as those given for the genus, but the grayer color of the face when contrasted with that of *Potos* may be pointed out as an additional aid in avoiding confusion with that genus.

Bassaricyon has been regarded as a rare animal, but the fact that it was met with at several localities and on several occasions at a single locality in Panama leads me to believe that it is rather common. While much less abundant than *Potos* its apparent rarity may have been due to failure in some instances to distinguish it from that animal when specimens were chosen, and to a lack of knowledge of its habits.

As in many other groups cranial modifications furnish more reliable differential characters than color. No material showing the color of *B. gabbii* at the type locality is available, but a specimen from near Gatun agrees very closely in cranial details with the type and coming, as it does, from within the same general faunal area may be regarded as typical. In this specimen the face is gray as usual in the genus, and not at all like Huet's (1883, pl. I) figure of the animal from " Caimito, dans la province de Correo, un peu au nord de Panama " (=the vicinity of Chorrera, about 17 miles southwest of Panama) and only about 30 miles from Gatun. Huet's figures of the skull, on the other hand, agree well with the type of *B. gabbii* and on geographic grounds might be expected to represent that species. Since the skulls from Gatun and near Chorrera agree closely with that of the type, typical *B. gabbii* is assumed to range from Costa Rica eastward to the Canal Zone. In eastern Panama typical *B. gabbii* is replaced by subspecies *B. gabbii orinomus* from which it differs in more brownish color, shorter postorbital processes, larger audital bullæ, and correspondingly narrower basioccipital.

The species seems to be arboreal and owing to nocturnal activity is likely to be overlooked unless special search is made for it. While using a hunting lamp one night in the forest along the lower course

of the Chagres River near Gatun one of these animals was located by the glare of its eyes in a tree top. When it was shot and dropped to the ground short muffled squeaking sounds and rustling branches were heard as several others, assumed to be of the same species, climbed rapidly away through the trees. The stomach of the example taken contained a small quantity of the pulp of some unidentifiable fruit. Several native hunters readily identified the specimen as an *olingo,* a name they apply also to *Potos,* and I found that they made no distinction between the two animals.

Specimens examined: Near Gatun, 1; Corozal, 1.

BASSARICYON GABBII ORINOMUS Goldman

Panama Bushy-tailed Olingo

[Plate 34, figs. 1, 1*a*]

Bassariscyon [sic] *gabbi orinomus* Goldman, Smiths. Misc. Coll., Vol. 60, No. 2, pp. 16-17, September 20, 1912. Type from Cana, eastern Panama (altitude 1,800 feet).

The form of *Bassaricyon gabbii* inhabiting the mountains of eastern Panama differs from typical *B. g. gabbii* of Costa Rica, western Panama and the Canal Zone in more tawny or paler fulvous, less brownish, coloration. It differs also in combination of cranial characters, the basioccipital being broader, the postorbital processes longer, more projecting, and the audital bullæ decidedly smaller.

It was met with on several occasions while hunting at night in the forest at about 2,000 feet near Cana, always among the upper branches of trees, its eyes appearing in the narrow field of light projected by the acetylene gas burner like those of *Potos*. In fact I rarely knew what animal I fired at until it came tumbling to the ground. The eyes are of course visible only when the animal has an unobstructed view toward the hunter, and unless a quick and effective shot is fired the game is apt to be lost. Like *Potos* these animals climb about in small parties; two were shot in the same tree and several others were heard making off. On one occasion a *Bassaricyon* was killed and another shot fired a moment later at a pair of eyes in the same tree brought down an example of *Potos*. Both species had, as the contents of their stomachs showed, been attracted by the ripening fruit in the top of the tree, a tall species unknown to me. A *Bassaricyon* shot at 5,000 feet near the summit of Mount Pirre was in the act of passing from the top of one tall tree to another.

Specimens examined: Cana, 5; Mount Pirre, 1.

Genus POTOS Geoffroy and Cuvier. Kinkajous

The kinkajous have short ears, short faces, rounded heads and bear a remarkable external resemblance to *Bassaricyon,* but are distinguishable by the round tapering, short-haired, prehensile tail. The tail perhaps furnishes the most convenient differential characters, but others are revealed by close inspection. The general color and proportions are similar, but *Potos* is a larger, more robust animal, and the face similar to the back in color; in *Bassaricyon* the face is grayish. The genus, a preëminently arboreal one, ranges northward in Middle America to the tropical portions of southern Mexico. Two forms are represented in Panama.

POTOS FLAVUS ISTHMICUS Goldman

Isthmian Kinkajou; Cusimbí

[Plate 34, figs. 2, *2a*]

Potos flavus isthmicus Goldman, Smiths. Misc. Coll., Vol. 60, No. 22, pp. 14-15, February 28, 1913. Type from near head of Rio Limon, Mount Pirre, eastern Panama (altitude 5,200 feet).

The Isthmian kinkajou is a rather common animal in the mountains of eastern Panama, being replaced farther west by the Chiriqui form of the group. Its known altitudinal range is from at least 1,000 feet on the slope to 5,200 feet near the summit of Mount Pirre. Contrasted with *P. f. chiriquensis* the present subspecies differs in the possession of a distinct black dorsal stripe; the skull is narrower interorbitally, the postorbital processes stouter, broader and more gradually tapering toward the base, instead of peg-like. The Isthmian race combines the color pattern of some of the South American forms with the heavier dentition of the Middle American forms.

The specimens obtained were all shot in trees at night, their eyes appearing reddish in color under the glare of the hunting lamp. Small parties or family groups are attracted by fruit and apparently revisit the same trees to feed night after night. This habit seemed to be shown by my meeting with them in the same vicinity on several occasions, and fallen fragments of fruit seen early in the morning indicated that frequent visits, presumably of these animals, were made. On approaching trees in which they were working a squeaking noise was commonly heard, coupled more rarely with short peculiar barks.

Under the name *Potos flavus chiriquensis* Anthony (1916, p. 372) lists specimens from Tapalisa (altitude 1,000 feet), and Tacarcuna

(altitude 2,650 to 5,200 feet). Concerning them, he says: "Two were taken from a hollow tree at Tacarcuna, two were shot by moonlight and with the jack light at the upper camp on Tacarcuna, and others were secured from the natives. At the upper camp this species came nightly to feed on what seemed to be a variety of wild fig, a fruit about the size of a man's thumb, with a pink center. Shortly after sun down, a small band of probably eight to a dozen individuals would be heard coming into the fruit trees. They travelled entirely through the trees and did not descend to the ground. Quantities of dead twigs and debris were shaken down by their weight, and their progress could be thus noted when the moving branches could not be seen.

"The eyes of the Kinkajou ('Cusumbi' or 'Manteja,' native names) shine strongly red under the jack light. One was eaten and its flesh proved to be quite palatable. A nasal, grunting sound was the only call heard."

Specimens examined: Cana, 4; Mount Pirre (type locality), 4; Tacarcuna, 4[1]; Tapalisa, 3.[1]

POTOS FLAVUS CHIRIQUENSIS Allen

Chiriqui Kinkajou; Olingo

Potos flavus chiriquensis ALLEN, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 72, February 29, 1904. Type from Boqueron, Chiriqui, Panama.

The Chiriqui kinkajou inhabits the western part of the republic and ranges as far east at least as the Canal Zone. It is replaced in eastern Panama by *P. f. isthmicus* which is distinguished by the possession of a distinct black dorsal stripe and a different combination of cranial characters, especially the narrower interorbital region and stouter more gradually tapering, less peg-like postorbital processes. The striking general resemblance of the species of *Potos* to those of *Bassaricyon* has been mentioned in the remarks on the genus.

A series of specimens from the vicinity of Gatun includes adults and young of both sexes showing a wide range of variation in the intensity of the general yellowish tawny color. A trace of the dark median dorsal stripe, which is more distinct in *Potos flavus isthmicus,* seems to indicate gradation toward that form.

The Chiriqui kinkajou seems to be one of the more common mammals of the region, but owing to nocturnal habits it is little known. Examples were obtained by shooting them from trees in the heavy forest where by the light of a hunting lamp their eyes were

[1] Collection Amer. Mus. Nat. Hist.

seen flashing among the branches. They hunt in small parties and several may sometimes be killed in a single tree. When approached a short, rather hoarse barking sound is sometimes given and a rustling noise may be heard as they climb or leap from branch to branch. Several kinds of wild fruits were found in the stomachs examined, including a common leguminous species known as "guava." Fruit seems to be their principal diet, but they doubtless feed on many other things. One partially filled stomach contained mainly fragments of large insects, but included small Coleopterous species swallowed entire. These kinkajous are easily tamed and often kept as pets, although they are inactive and remain curled up in a corner during the day, and are inclined to be mischievous at night. A rather young individual, which had recently been caught in the forest, climbed to my shoulder and sat with its long tail coiled about my neck.

Bangs (1902, p. 49) listed specimens collected by W. W. Brown, Jr., at Bogava and remarks: "I do not think the Central American form is the same as true *P. caudivolvulus* of Surinam, but I have not sufficient material to decide the question." Under the name *Potos flavus megalotis,* Thomas (1903*a*, p. 40) recorded specimens probably referable to *P. f. chiriquensis* from Parida, Sevilla, and Almijas, all small islands near the southern coast of western Panama.

The name applied to the animal by natives of the Canal Zone is "olingo."

Specimens examined: Boqueron, 6[1]; Bogava, 3[2]; Gatun, 15.

Family MUSTELIDAE. Weasels, Tayras, Grisons, Skunks, Otters, etc.

The family, as restricted within our limits, includes a weasel of the familiar type, the tayra and grison, large powerful weasel-like animals, a long-nosed skunk, and an otter.

Subfamily MUSTELINAE. Weasels

Genus MUSTELA Linnaeus. Weasels

The weasels, mainly boreal in distribution, are represented in the region by a single form which ranges well into South America. Its small size, elongated body, short limbs, and hairy soles of hind feet distinguish it from the other carnivores of the region. The white facial markings present in the northern forms are absent or barely indicated by a few white hairs in front of the ears.

[1] Collection Amer. Mus. Nat. Hist.

[2] Collection Mus. Comp. Zool.

Subgenus MUSTELA Linnæus

MUSTELA AFFINIS COSTARICENSIS Goldman

Costa Rican Bridled Weasel

Mustela costaricensis GOLDMAN, Proc. Biol. Soc. Washington, Vol. 25, p. 9, January 23, 1912. Type from San José, Costa Rica.

The weasel of Panama may be referred to the Costa Rican subspecies of *Mustela affinis,* but is somewhat darker than the typical form and in the smaller skull, with less elongated braincase and relatively smaller, more flattened audital bullae, approaches *M. f. affinis* of Colombia. It seems to be distributed nearly throughout the republic, and the localities for specimens show an altitudinal range from sea level to over 5,000 feet.

Specimens were taken by me in traps. At Gatun one was attracted to a trap baited with the feathered body of a dead bird. Near the summit of Mount Pirre, on visiting a spot where I had placed a trap for small rodents under shelter of the wide spreading aerial roots of a tree, I found that some animal had carried off the trap; but bristles and some viscera of *Heteromys* left on the ground showed that some carnivorous species had anticipated me. A steel trap was set in the same place, and next morning held a weasel which bit savagely at the toe of my shoe when extended to within reach.

Under the name *Mustela brasiliensis,* Alston (1879, p. 78) records the species as obtained in Panama by M. Boucard. Bangs (1902, p. 49) referred to *Putorius affinis* three specimens collected at 4,000 to 5,800 feet near Boquete by W. W. Brown, Jr. He found that the examples agreed very well with Gray's description, but varied somewhat among themselves in color; a young individual had a wholly black head while the two adults had small irregular (not the same on both sides) white patches, behind the eye, in front of the ear, and above the corner of the mouth. The chins were white in all three, and the rest of the under parts varying shades of orange rufous. A specimen also from Boquete, taken by J. H. Batty, was assigned to *P. affinis* by Allen (1904, p. 72) who noted a similar irregularity of the white markings. He says " on the right side of the head are a few white hairs, scattered singly over the whole side of the head from eye to ear; on the left is a very small oblong white spot just behind the eye, and another somewhat larger white spot in front of the lower base of the ear."

Partial or complete obliteration of the white facial markings usually present in weasels of this group is also shown in the specimens collected by me, in one of which the face is entirely black

while in the other there are small, very narrow elongated patches of white hairs in front of the ears.

Specimens examined: Boquete, 4[1]; Mount Pirre, 1; Rio Indio (near Gatun), 1.

Subfamily MELINAE. Tayras, Skunks

Genus TAYRA Oken. Tayras

The genus *Tayra,* as represented in Panama, is a large weasel-like animal, black in general color, but with the head and neck brown. The single form known from the region is a link in a chain of subspecies extending from South America north to southern Mexico.

TAYRA BARBARA BIOLOGIAE (Thomas)

Panama Tayra

Galictis barbara biologiae THOMAS, Ann. Mag. Nat. Hist., Ser. 7, Vol. 5, p. 146, January, 1900. Type from Calovevora, Veragua, Panama.

The tayra is the largest and most powerful Middle American member of the family. In its several forms it ranges uninterruptedly from South America north to southern Mexico. The Panama race was based on a female from Calovevora which Thomas (*l. c.*) regarded as a smaller animal than *T. b. senex* of Mexico. Comparison of fully adult males, however, seems to indicate that the reverse is true. *T. b. biologiæ* differs otherwise from *T. b. senex* in the brownish instead of grayish head and neck. An adult male from Chunchumayo, Peru, assumed to represent *T. b. peruana* Tschudi seems to differ from *T. b. biologiæ* in the lighter color of the head and neck and somewhat smaller skull with noticeably smaller teeth.

A fine male, without a breast spot, obtained at Gatun, was shot one day as it slowly descended the trunk of a tree in the forest. No others were observed by me, but the species is not infrequently killed by hunters. I saw several skins taken by American hunters at Gatun who, for lack of a better vernacular name, referred to the animals as "black cats."

Under the specific name *Galictis barbara,* Alston (1879, p. 80) mentions specimens received by the Zoological Society of London from Panama. Bangs (1902, p. 49) in noting a specimen collected for him at Bugaba by W. W. Brown, Jr., says: "The black-headed Central American form is a very strongly marked subspecies." Anthony (1916, p. 372) lists specimens from Tacarcuna and Tapalisa, exhibiting considerable range of individual variation, especially in

[1] Three in collection Mus. Comp. Zool.; one in Amer. Mus. Nat. Hist.

the color of the head. He says: "Upon the one occasion when this animal was encountered by our party, I found it to be most interesting, it having marked resemblance in behavior to our northern weasels and martens. It was exceedingly curious and unafraid."

Specimens examined: Bugaba, 1[1]; Gatun, 1; Tacarcuna, 3[2]; Tapalisa, 3.[2]

Genus GRISON Oken. Grisons

The genus *Grison* includes a large, weasel-like animal, smaller, however, than *Tayra* and differing conspicuously in color. A broad white line extends across the forehead, over the ears and on to the sides of the neck; the limbs and the face to above the eyes are black; the back is mixed black and gray, producing a grizzled effect. The line across the forehead suggests the white facial markings commonly present in the weasels. The soles of the hind feet, unlike those of the weasels, are naked.

GRISON CANASTER (Nelson)

Yucatan Grison

Galictis canaster Nelson, Proc. Biol. Soc. Washington, Vol. 14, p. 129, August 9, 1901. Type from near Tunkas, Yucatan.

A grison was shot one night on or near the ground in the forest at 1,800 feet altitude near Cana. It was located by the glare of its eyes in the field of light projected from a hunting lamp, but the identity of the animal was not suspected until it was picked up. The example, a female, is provisionally referred to *G. canaster*, the type of which is now in the collection of the Biological Survey. It closely resembles *G. canaster* except that the dark element of the pelage is nearly pure black instead of dark brown; but the type of *G. canaster* was mounted and probably exposed to the light for several years during which time it may have faded. In comparing the skull of this female specimen with that of the type of *G. canaster*, a male, differences noted in the size of the teeth are those usually found when Mustelidæ of opposite sexes are examined. A specimen in the National Museum from Talamanca, Costa Rica, agrees closely in all essential respects with the one from Panama and may be referred to the same form. While the Middle American specimens may conditionally be assigned to *G. canaster* of Yucatan, the relationship of that form to typical *G. allamandi* Bell and to *G. crassidens* Nehring[3] of Brazil is some-

[1] Collection Mus. Comp. Zool.

[2] Collection Amer. Mus. Nat. Hist.

[3] For discussion of these forms see Nehring, Sitzungsber. der Gesellsch. naturforsch. Freunde zu Berlin, pp. 209-216, Nov. 19, 1901.

what problematical owing to the absence of adequate material for comparison. The Middle American animal is much grayer above than *G. allamandi,* as shown in the figure accompanying the description,[1] and the white of the frontal region passes rather gradually into the grayish color of the top of the head, there being no sharp line of demarcation as indicated in the figure of *G. allamandi*

Specimens examined: Cana, 1.

Genus CONEPATUS Gray. Skunks

In this genus of skunk the snout is very long, projecting well beyond the lower jaw, with a large naked pad on the upper side. The claws of the front feet are long and stout and the soles of the hind feet are naked to the heels. The tail is rather short. The skunks of the genus *Conepatus* are by their structure better fitted for rooting in the ground than are the members of the more boreal genera *Mephitis* and *Spilogale.*

Subgenus MARPUTIUS Gray

CONEPATUS TROPICALIS TRICHURUS Thomas

Panama Skunk

Conepatus tropicalis trichurus THOMAS, Ann. Mag. Nat. Hist., Ser. 7, Vol. 15, p. 585, June, 1905. Type from Boquete, Chiriqui, Panama (altitude 4,000 feet).

The Panama skunk is described as apparently similar to *Conepatus tropicalis tropicalis* of Mexico, but with a decidedly longer tail, the black element of which is restricted to a shorter area at the base. The white dorsal stripes are also represented as shorter. The fur of the back is coarse, sparse, not very long and "less mixed with wool-hairs than in *C. mapurito*" of South America.

The species was based on five specimens from western Panama and Costa Rica, of which the type was collected by H. J. Watson on the Volcan de Chiriqui.

Two specimens collected by W. W. Brown, Jr., at Boquete were recorded by Bangs (1902, p. 48) as *Conepatus mapurito.* Under the same name Allen (1904, p. 72) noted an example taken by J. H. Batty at Boqueron.

No skunks were met with by me in the Darien region of eastern Panama, but native hunters reported their rare occurrence in the vicinity of Cana.

Specimens examined: Boqueron, 1[2]; Boquete (type locality), 2.[3]

[1] Trans. Zool. Soc. Lond., Vol. 2, pp. 204-205, pl. 35, 1837. (Also described in Proc. Zool. Soc. Lond., 1837, pp. 47-49.)

[2] Collection Amer. Mus. Nat. Hist.

[3] Collection Mus. Comp. Zool.

Subfamily LUTRINAE. Otters

Genus LUTRA Brisson. Otters

The otter is aquatic in habits and differs conspicuously in appearance from all the other mammals of the region. The body is elongated and supple and the limbs are short as usual in the family; the ears are very short, the tail is rather long, tapering, and somewhat flattened. The otter is much prized for its beautiful fur. Unlike the forms of the more northern *L. canadensis* group the otters of Middle America have the nose pad haired to near the upper border of the nostrils; the soles of the feet are entirely naked; the tufts of hair under the toes and the granular tubercles present on the soles of the hind feet in *L. canadensis* are absent.

LUTRA REPANDA Goldman

Panama Otter; Nutria

[Plate 35, figs. 1, 1*a*]

Lutra repanda GOLDMAN, Smiths. Misc. Coll., Vol. 63, No. 5, p. 3, March 14, 1914. Type from Cana, eastern Panama (altitude 2,000 feet).

The otters inhabiting the general region as far west at least as the Canal Zone and from sea level to 2,000 feet altitude or higher belong to a rather small species much more closely allied to *L. colombiana* of Colombia than to the other known Middle American forms. It apparently differs from *L. colombiana* in a number of cranial details, the rostrum and interorbital space being narrower; the lachrymal eminence more prominent, projecting as a distinct process on the anterior border of the orbit; the jugal less expanded vertically; the palate reaching farther posteriorly beyond the molars; the upper carnassial narrower, with the inner lobe less produced posteriorly, leaving a gap which is absent in the type of *L. colombiana;* the upper molar narrower, with the posteroexternal cusp set inward giving the crown a less evenly rectangular outline. Contrasted with that of *L. latidens* of Nicaragua, the skull is very much smaller and the two appear to be specifically distinct.

The specimens secured were brought to me by hunters who reported seeing them in small streams where they were shot during the day. According to the natives otters occur rather sparingly along small streams throughout the region. Near the mouth of the Chagres River they live along the banks of creeks up which the tide runs for some distance.

Under the name *Lutra felina,* Alston (1879, p. 86) records the otter as received through M. Boucard from Panama. Anthony

(1916, p. 372) in listing specimens from Tapalisa says: "I shot one near the junction of the Rio Tapalisa and the Rio Tacarcuna, but the wounded animal was lost in the rapid stream. Indian hunters brought in two." The animal is known as *nutria* to natives of the Canal Zone.

Specimens examined: Cana, 1; Gatun, 1; Tapalisa, 2.[1]

Family FELIDAE. Cats

The cats of the region under review are comprised in two genera; the genus *Felis,* which is well represented by the jaguar, the puma, the ocelot, and the long-tailed spotted cat; and the genus *Herpailurus* including only the yagouaroundi.

Genus FELIS Linnaeus. Cats

The cats assigned to the genus *Felis* vary considerably in size and color. The jaguar, the ocelot, and the long-tailed spotted cat are recognizable by their profusely spotted color pattern; the puma is fairly familiar as a big plain colored animal.

FELIS ONCA CENTRALIS Mearns

Central American Jaguar; Tigre

Felis centralis Mearns, Proc. Biol. Soc. Washington, Vol. 14, p. 139, August 9, 1901. Type from Talamanca, Costa Rica.

The jaguar, the largest of American cats, ranges from far south in South America north through the tropical parts of Middle America and occasionally reaches the southern United States. Several forms, apparently geographic races assignable to a single species, have been described, but their exact relationships are imperfectly known. *F. o. centralis* seems to be a comparatively small subspecies.

No specimens were obtained by me, but tracks probably of this subspecies were seen along the forested banks of the Rio Tuyra a few miles above Real de Santa Maria. Anthony (1916, p. 371) records a specimen killed by an Indian hunter at Boca de Cupe. The jaguar is well known as "tigre" to native hunters and is said by them to occur here and there throughout the region, favoring districts where deer and peccaries are abundant. Imperfect skins from indefinite localities were seen in the market in the city of Panama. Black individuals, doubtless melanistic examples, are to be found occasionally in the Darien region. They are supposed by some to be a distinct species known as "tigre negro."

[1] Collection Amer. Mus. Nat. Hist.

While the jaguar is large and powerful enough to be very dangerous, I was unable to learn of an authentic case of an unprovoked attack on man. When surrounded it is said to fight stubbornly and sometimes kills dogs used in the chase. But even when harried by hounds it prefers to keep moving, seeking to escape to the densest parts of the forest. In order to avoid dogs the jaguar may climb into trees where it is easily approached and shot. At Chepo I learned that wandering jaguars periodically kill cattle ranging on the savannas between that point and the city of Panama.

The occurrence of the species in the Canal Zone was noted by Maack (1874, p. 171) who in the course of his extended journey saw one only, near the railway between Buenavista and Bohio. He says: "I came to within about twelve paces of it, but as soon as the animal saw me it ran away. It seems that these larger cats (referring in part to the ocelot) are very shy and cowardly, and prefer the most concealed life in the very middle of the forests."

Specimens examined: Boca de Cupe, 1.[1]

FELIS PARDALIS MEARNSI Allen

Mearns' Ocelot; Manigordo; Tigre Chico

Felis mearnsi ALLEN, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 71, February 29, 1904. (Substitute for *F. costaricensis* Mearns, which is preoccupied by *F. bangsi costaricensis* Merriam.) Type from Talamanca, Costa Rica. (Probably from near Sipurio in the valley of the Rio Sicsola.)

The ocelot is the most abundant of the spotted cats of Middle America. *F. p. mearnsi* is a large southern form of the *F. pardalis* group easily distinguished from the jaguar by much smaller size and the presence of about four parallel black stripes on the nape and oblique stripes near the shoulders. In the jaguar these areas are black spotted instead of striped. While the two animals are widely different in size large ocelot skins represented to be those of the jaguar are sometimes sold at high prices to unsuspecting purchasers who may by noting the above markings avoid deception. The ocelot of Panama closely resembles the long-tailed spotted cat of the same region in profusely spotted and striped coloration, but is a much larger more robust animal with a shorter tail; the tail of the ocelot measures about 350 millimeters while that of the long-tailed spotted cat as represented by the type is 440 millimeters in length.

Several ocelots were seen during the day resting among the branches of trees. When approached they usually tried to escape by climbing slowly and stealthily out of sight, but when discovery

[1] Collection Amer. Mus. Nat. Hist.

became certain they ran down the trunks of the trees to the ground and, unless killed by a quick shot, promptly disappeared in the forest. On several occasions while hunting in the forest I had glimpses of ocelots crossing small openings among the trees, but none were encountered while using a hunting lamp at night.

Bangs (1902, p. 48) records the collection of a fine adult male at 4,000 feet altitude near Boquete by W. W. Brown, Jr. Under the name *Felis mearnsi,* proposed as a substitute for *Felis costaricensis* Mearns (which proved to be preoccupied by *F. bangsi costaricensis* Merriam for the puma), Allen (1904, p. 71) notes a specimen obtained by J. H. Batty at Boqueron. Anthony (1916, p. 371) lists a specimen from Real de Santa Maria.

Native names for the ocelot in the Canal Zone are "manigordo" and "tigre chico," the former also used in Costa Rica for the same animal and meaning literally thick paws, in allusion to its large feet.

Specimens examined: Boqueron, 1[1]; Boquete, 1[2]; Gatun, 3; Mount Pirre, 1; Punta de Peña (near Bocas del Toro), 1; Real de Santa Maria, 1.[1]

FELIS PIRRENSIS Goldman

Panama Long-tailed Spotted Cat

[Plate 36, figs. 1, 1*a*]

Felis pirrensis GOLDMAN, Smiths. Misc. Coll., Vol. 63, No. 5, p. 4, March 14, 1914. Type from Cana, eastern Panama (altitude 2,000 feet).

This species closely resembles the ocelot in heavily spotted and striped coloration, but differs in more slender form and longer tail; the tail of the type measures 440 millimeters in length (nearly 100 millimeters more than is usual in the ocelot).

In the original description I provisionally referred this animal to the little-known *F. pardinoides* group, with the remark that "in size it seems nearer to the *F. wiedii* group, but it lacks the reversed pelage of nape commonly ascribed to that group." I have since become convinced that the direction taken by the pelage of the nape is apt to be untrustworthy as a distinctive character; the animal is more probably a large member of the *F. wiedii* group which is represented farther north in Middle America by *F. glaucula,* a smaller, grayer colored animal. It is to this group of spotted cats that the name *Felis tigrina* seems to have been applied by writers on the cats of Middle America, a name which in the light of present knowledge

[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Mus. Comp. Zool.

scarcely seems entitled to a place in our faunal lists. Although inhabiting the same region as the ocelots, the spotted cats of this group are rather rare as evinced by the small number of specimens that have found their way into collections.

The specimen on which the species is based was brought to me by a hunter who shot it in the forest near Cana. It had been disemboweled and the hunter reported finding its stomach well filled with undigested pieces of a large opossum, *Didelphis marsupialis etensis.*

Specimens examined: Cana, 1 (type).

FELIS BANGSI COSTARICENSIS Merriam

Central American Puma; León

Felis bangsi costaricensis MERRIAM, Proc. Washington Acad. Sci., Vol. 3, p. 596, December 11, 1901. Type from Boquete, Chiriqui, Panama.

Among American cats the pumas or mountain lions are second only to the jaguars in point of size. They are easily distinguished by large size, and the absence of body markings, except in very young individuals.

A number of forms have been described, but their relationships are little known. Collectively they range from southern Patagonia to southern Canada and ascend from sea level to the upper slopes of high mountains. While the forms vary considerably in general size and cranial details, no two appear to inhabit the same area and many facts point to the probability that all are geographic races of *Felis concolor* Linnæus. The animal has figured prominently in stories of adventure in many regions, but is much less dangerous than is commonly believed. Some popular misconception in regard to it is due to the various vernacular names, such as puma, cougar, panther and mountain lion which are supposed by many to apply to distinct species which may occur at the same localities. Throughout Middle America the animal is generally known to the natives as "león."

The Central American puma is characterized by rather small size and rich reddish coloration. It occurs here and there throughout Panama, but is rarely seen. On the stock ranges of the savanna region near the Pacific coast horses and calves are said to be attacked and killed by pumas, but such incidents are apparently of rare occurrence. Like the jaguar the puma is said to follow the deer and peccaries and is most likely to be found in localities where these animals are abundant.

The type of *F. b. costaricensis* was collected by W. W. Brown, Jr., for Outram Bangs at 4,000 feet altitude near Boquete on the southern

slope of the Volcan de Chiriqui. An example from the bank of the Bayano River, 10 miles above the mouth of the Mamoní River, was shot by H. B. Johnson of the Canal Zone police, who reported finding it crouched on the ground and in the act of stalking a deer. The specimen is similar to the type in rich reddish color. A skin without skull obtained by J. H. Batty at Boquete is recorded by Allen (1904, p. 70), who says of it: "This specimen agrees with Dr. Merriam's description of the type, from Boquete. The sides are bright reddish; the median dorsal region is much darker—or dark reddish chestnut—as is also the dorsal area of the tail; the tail darkens apically, so that the apical half is decidedly blackish, the tip being wholly black for the terminal two inches. The inguinal region is pure white, a small pectoral area whitish, and the intervening region is like the flanks but much paler. Fur between toe pads black; ears almost wholly black, the usual lighter areas being brownish black and the rest deep black."

Specimens examined: Bayano River, 1; Boqueron, 1[1]; Boquete, 1.[2]

Genus HERPAILURUS Severtzow

The single species referable to this genus, commonly accorded subgeneric rank only, is a small, slender, long-tailed cat, with variable but unspotted coloration, ranging from Paraguay northward through the warmer parts of middle America to southern Texas. Generic distinction seems well shown in the skull. Contrasted with *Felis* the more differential characters are the elongation and lateral compression of the cranium, accompanied by the greater elevation of the rostrum in combination with the relatively short canines, the height of the latter being less than that of the anterior nares. Unlike normal *Felis* the outer instead of the inner side of the upper sectorial is longest owing to the suppressed or vestigial condition of the protocone. The foramen ovale is placed well behind the level of the glenoid cavity, a position unusual among cats, and apparently associated with the elongation of the braincase.

HERPAILURUS YAGOUAROUNDI PANAMENSIS (Allen)

Yagouaroundi; Panama Gray and Red Cat

Felis panamensis ALLEN, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 71, February 29, 1904. Type from Boqueron, Chiriqui, Panama.

Herpailurus yagouaroundi seems to be a dichromatic species presenting gray and red color phases of varying tone. *H. y. panamensis* is a dark geographic race of which the only known specimens are

[1] Collection Amer. Mus. Nat. Hist.

[2] Collection Mus. Comp. Zoöl.

in the grayish phase, the dark brown or black and the buffy gray elements of the pelage being finely mixed and producing a grizzled effect; but individuals of the less common reddish phase may be expected to occur in the region.

A specimen obtained in the forest near Cana was shot by one of my assistants who found it in a tree. Alfaro[1] states that in Costa Rica this animal is called "león miquero" because of its fondness for travelling over the branches of large forest trees. Alston (1879, p. 63) states that "M. Boucard has received the Yaguarundi from Veragua."

Specimens examined: Boqueron, 1[2] (type); Cana, 1; Empire, 1; Lion Hill, 1.[3]

Order INSECTIVORA. Insectivores

Family SORICIDAE. Shrews

The shrews are small mouse-like creatures, distinguished externally by short, dense, very dark colored fur, long, pointed noses, tiny feet, and in our southern groups, inconspicuous ears. In America the family reaches its greatest development in more northerly latitudes and a single genus is known from Panama.

Subfamily SORICINAE. Shrews

Genus CRYPTOTIS Pomel. Shrews

The shrews of this genus inhabit mainly the mountains of middle America, but at least one species ranges at low elevations in the southern United States and several have been described from northwestern South America. The single species found in Panama is perhaps the smallest four-footed mammal of the region. The skull is low and flat, without zygomata or audital bullae; the teeth are 30 in number.

CRYPTOTIS MERUS Goldman

Mount Pirre Shrew

[Plate 37, figs. 1, 1*a*]

Cryptotis merus Goldman, Smiths. Misc. Coll., Vol. 60, No. 2, p. 17, September 20, 1912. Type from near head of Rio Limon, Mount Pirre, eastern Panama (altitude 4,500 feet).

The discovery of this small black shrew close to the Colombian frontier materially extends the known range of the *Cryptotis mexi-*

[1] Mamiferos de Costa Rica, 1897, p. 17.
[2] Collection Amer. Mus. Nat. Hist.
[3] Collection Mus. Comp. Zool.

cana group eastward from Costa Rica. The group is represented in Costa Rica by *C. orophila* Allen, which differs from *C. merus* in somewhat larger size, decidedly larger claws, paler color, and in cranial details. No shrews are known from western Panama, but one or more species doubtless inhabit the Volcan de Chiriqui.

Three specimens of the present species were trapped under logs on steep banks at from 4,500 to 5,000 feet altitude near the headwaters of the Rio Limon. The banks of streams in this vicinity are very wet and heavily overgrown with ferns.

Specimens examined: Three, from the type locality.

Order CHIROPTERA. Bats

Family EMBALLONURIDAE. Sac-winged Bats; White Bats

The bats of this family are slender species, with large interfemoral membrane perforated by the tail which appears on the upper surface a short distance from the edge. The limbs are very slender, the forearm strongly curved. Most of the genera have glandular sacs or recesses in the antebrachial membranes. These sacs are well developed and conspicuous in the males, but are more rudimentary and inconspicuous in the females and for this sex do not, therefore, always furnish satisfactory distinguishing characters. Some of the genera are marked by two parallel whitish dorsal stripes; others are plain, dark colored, and the genus *Diclidurus* is white. The postorbital processes are long and curved, except in the genus *Diclidurus*, in which they are very short and straight. There is no nose leaf.

Subfamily EMBALLONURINAE

Genus RHYNCHISCUS Miller

The genus *Rhynchiscus* includes diminutive, butterfly-like bats with remarkably long, projecting noses. As in the genus *Saccopteryx* there are whitish dorsal stripes, but unlike the other genera of the subfamily inhabiting the region, there are no wing sacs. Perhaps the most readily distinctive characters are the haired tibia and tufts of grayish fur placed at intervals along the outer side of the forearm. The teeth are 32 in number. A single known species ranges from Brazil to Mexico.

RHYNCHISCUS NASO PRISCUS G. M. Allen

Mexican Long-nosed Bat

Rhynchiscus naso priscus G. M. Allen, Proc. Biol. Soc. Washington, Vol. 27, p. 109, July 10, 1914. Type from Xcopen, Quintana Roo, Mexico.

The Mexican long-nosed bat is a small species (forearm about 38.5) with two whitish stripes extending along the back much as in

the species of *Saccopteryx*. It is smaller than the latter, however, and easily distinguished by the buffy gray instead of glossy brown general color, and the characters given for the genus.



FIG. 1.—Rhynchiscus naso priscus.
No. 179843, U. S. Nat. Mus. About nat. size.

Specimens from Panama are apparently somewhat intermediate in characters, but referable to this recently described subspecies, which differs from typical *R. naso* of Brazil most notably in the form of the anterior upper premolar.

A colony of 13 individuals was found suspended from the under side of a concrete bridge on the Panama Railroad about half a mile north of Corozal. They occupied a strongly lighted space about two feet in diameter, and were conspicuous against the light-colored background of masonry. Ten specimens, now in the Field Museum of Natural History, were collected at Lagartera on the Rio Trinidad by Dr. S. E. Meek.

Specimens examined: Corozal, 13; Lagartera, 10.

Genus SACCOPTERYX Illiger

The sac-winged bats usually encountered belong to this genus. Whitish dorsal stripes are present as in *Rhynchiscus,* but the tibia and forearm are naked instead of clothed with grayish tufts of fur as in that genus. Glandular sacs are conspicuous in the wings of the males, but are less easily detected in those of the females. The genus is similar to *Centronycteris,* but more robust in general structure and the skull differs in the greater lateral expansion of the lower border of the orbit, which overhangs and hides the toothrow when viewed from above. The ears are moderately long, narrow and pointed. The teeth are 32 in number. Two species of the genus range in Panama.

SACCOPTERYX BILINEATA BILINEATA (Temminck)

Greater White-lined Bat

Urocryptus bilineatus TEMMINCK, Vander Hoeven's Tijdsch. Natuurlij. Gesch., Vol. 5, p. 33, pl. 2, figs. 3-4, 1838-1839. Type from Surinam, Dutch Guiana.

Like the still smaller species *Saccopteryx leptura,* which it very closely resembles, this small bat has two white longitudinal stripes near the center of the back. It is not unlike *Rhynchiscus naso* in the

arrangement of the stripes, but is larger (forearm about 47.5 mm.) and the general color glossy brown or black instead of buffy gray. The males possess a well-developed glandular sac in the antebrachial membrane near the inner side of the forearm; in the females this sac may be difficult to find. Specimens from Panama appear to represent typical *S. bilineata* and differ in larger size from examples of *S. b. centralis* from Mexico. This difference seems most noticeable in the skulls.



FIG. 2.—Saccopteryx bilineata bilineata.
No. 179849, U. S. Nat. Mus. About nat. size.

Near Gatun a colony of 15 of these bats was found in the space between the projecting buttresses on the trunk of a large tree in the forest. They were clinging to the bark about 10 feet from the ground and in plain view. At Tabernilla half a dozen were located in the open smokestack of an old French dredge which had beeen abandoned and was lying in second growth forest near the railroad. They were irregularly distributed over the smooth inner surface and hanging motionless with their muzzles somewhat elevated or pointing outward, beyond the plane of their backs. Bats of this species were discovered under shelter of the high arch of the natural bridge over the Rio del Puente, a few miles north of Alhajuela. Here they were grouped in dark recesses from which they were dislodged by shooting. A specimen picked up from the ground where it had fallen with the others proved to be *Peropteryx canina*. A few greater white-lined bats were also obtained from crevices in a small well-lighted cave in the cliff forming the coast line a short distance west of the entrance to the Panama Canal at Balboa. Clinging in or near the same crevices in the cave walls were a few *Hemiderma p. aztecum* and *Glossophaga soricina leachii*.

On Taboga Island August Busck met with *S. b. bilineata* clinging to sun-exposed rocks at the entrance to a cave. None were found beyond the entrance. Anthony (1916, p. 373) records a specimen taken by W. B. Richardson at Cituro.

Specimens examined: Alhajuela, 2; Balboa, 1; Cana, 1; Cerro Azul, 1; Cituro, 1[1]; Gatun, 5; Rio del Puente (natural bridge north of Alhajuela), 6; Tabernilla, 1; Taboga Island, 10.

[1] Collection Amer. Mus. Nat. Hist.

SACCOPTERYX LEPTURA (Schreber)

Lesser White-lined Bat

Vespertilio lepturus SCHREBER, Saugethiere, Vol. 1, p. 173, pl. 57, 1774. Type from Surinam.

The lesser white-lined bat closely approaches *Saccopteryx bilineata* in general appearance, the glossy dark brown or blackish color and two white dorsal lines being about the same. It is a distinct species, however, differing in decidedly smaller size (forearm about 42.3 millimeters).

Two of these bats shot as they circled at dusk over the bank of the Chagres River at Alhajuela, January 29, 1912, were the only examples secured. This South American species has not previously been recorded from Middle America.

Specimens examined: Alhajuela, 2.

Genus PEROPTERYX Peters

In general structure this genus is similar to *Saccopteryx,* but the skull exhibits a much more inflated and generally rotund condition of the rostrum, the back lacks dorsal stripes and the wing sacs are smaller and advanced to near the anterior border of the antebrachial membranes. The teeth are 32 in number. A single species is known.

PEROPTERYX CANINA CANINA (Wied)

Dog-like Bat

Vespertilio caninus WIED, Schinz's Theirreich, Vol. 1, p. 179, 1821. Type from east coast of Brazil.

There is nothing especially dog-like about this bat as the name " canina " might be taken to indicate. It is a small species much like those of the genus *Saccopteryx* in external appearance except that, as indicated under the genus, the dorsal lines present in the latter are absent.

One was picked up from the ground where it had fallen along with a small number of *Saccopteryx bilineata* that were dislodged by shooting into dark recesses under the high arch of the natural bridge over the Rio del Puente, a few miles north of Alhajuela. Ten specimens in the Field Museum of Natural History were collected at Balboa by Messrs. Osgood and Anderson. This bat, originally described from Brazil and ranging to southern Mexico, is one of the few species that apparently maintain the same characters throughout this wide interval and on the continent show no tendency toward subspecific division. A subspecies, *Peropteryx canina phæa,* G. M. Allen, has been described from the Lesser Antilles.

Specimens examined: Balboa, 10; Gatun, 1; Rio del Puente, 1.

Genus CENTRONYCTERIS Gray

Similar to *Saccopteryx*, but more slender in general structure. Skull with the lower border of the orbit so slightly projecting that the toothrow is visible from above, instead of hidden as in *Saccopteryx*. The teeth are 32 in number. The genus, mainly South American in distribution, is represented in Panama by a single species.

CENTRONYCTERIS CENTRALIS Thomas

Thomas' Bat

Centronycteris centralis THOMAS, Ann. Mag. Nat. Hist., Ser. 8, Vol. 10, p. 638, December, 1912. Type from Bugaba, Chiriqui, Panama (altitude 800 feet).

The only record of this bat is the description of the type, and only known specimen, which was collected in western Panama, at the locality given above, by H. J. Watson.

The species is " Nearly allied to *C. maximiliani,* but slightly larger, colour rather darker, and basi-sphenoid pits of skull markedly shorter.

" Fur long and loose; hairs of back about 6.5 mm. in length. General colour above dark tawny brown, that of a Para example of *C. maximiliani* somewhat paler. Basal third of interfemoral well clothed with long hairs." The forearm measurement given is 45 millimeters. The species is said to be mainly distinguishable from *C. maximiliani* by the much shorter basi-sphenoid pits which do not extend forward between the pterygoids as in *C. maximiliani* of South America.

Subfamily DICLIDURINAE

Genus DICLIDURUS Wied

The species of the genus *Diclidurus* are white, a color very unusual among bats. The ears, unlike those of other genera of the family known to occur in Panama, are short and rounded. The skull presents remarkable features, the braincase, flattened anteriorly, descending abruptly to the rostrum which is very broad and depressed, with elevated lateral margins. There is no wing sac. The teeth are 32 in number.

DICLIDURUS VIRGO Thomas

Costa Rican White Bat

Diclidurus virgo THOMAS, Ann. Mag. Nat. Hist., Ser. 7, Vol. 11, p. 377, April, 1903. Type from Escazu, Costa Rica.

The Costa Rican white bat was not met with by me, but in the original account of the species Mr. Oldfield Thomas records speci-

mens from "Pueblo Nuevo, N. W. Panama," and from Boquete, Chiriqui.

The color of the upper parts, described as pure white or gray-mixed, should render this species conspicuous among the bats of the general region. The length of the forearm is 66 millimeters. The species is said to agree in general character with *Diclidurus albus* of Brazil, but has differently shaped incisors and premolars.

Family NOCTILIONIDAE. Bull Dog Bats

The bats of this family are rather large, with narrow, sharp-pointed ears which, when laid forward, reach about to the end of the nose. The short tail protrudes from the upper side of the interfemoral membrane. The pelage is short and on the lower part of the back confined to the median portion. There is no nose leaf. The upper canine teeth curve widely apart and project conspicuously over the lower jaws. The elongated middle pair of upper incisors are in contact near the middle, but diverge leaving a deep emargination between their conical points. The outer pair of upper incisors are very short, barely reaching the cingulum of the inner pair behind which they are partially hidden. Two genera are recognized, the typical one, *Noctilio,* including a large, long-legged, ochraceous-tawny species not yet recorded from Panama, although it probably occurs there. This species is noted for its alleged fish-eating habits. The family is represented on the Isthmus by the genus *Dirias*.

Genus DIRIAS Miller

The genus *Dirias* is very similar to *Noctilio* in general structure, but differs considerably in appearance owing to smaller size, dark coloration and relatively short legs. The skull closely resembles that of *Noctilio,* but the teeth are more delicate in sculpture and differ in detail. The upper molars are more closely crowded; instead of forming prominent cusps with distinct commissures the hypocones of the first and second are shelf-like, with trenchant lateral margins connecting with ridges extending upward to protocone and metastyle. The teeth are 28 in number.

DIRIAS ALBIVENTER MINOR (Osgood)

Little Bull Dog Bat

Noctilio minor Osgood, Field Mus. Nat. Hist., Publ. 149, zool. ser., Vol. 10, p. 30, October 20, 1910. Type from Encontrados, Zulia, Venezuela.

A Panama specimen of this bat is a very dark shade of brown, or near bone brown (Ridgway, 1912) above, with a faint grayish median

stripe down the posterior part of the back; the underparts are whitish. It is a robust animal with large feet, and narrow ears tapering to slender points. The fur is short. The forearm measures about 60 millimeters.

The form was known only from Venezuela until recorded from Empire, Panama, by E. W. Nelson (1912, p. 93). The record was based on an individual shot flying across an old pineapple field near Culebra Cut just at dusk, February 2, 1912. Several others appeared at the same time and all had doubtless just come from some hiding



Fig. 3.—Dirias albiventer minor.
No. 179848, U. S. Nat. Mus. About nat. size.

place in the vicinity. They flew with rapid wing strokes, passing at a height of about 30 feet from the ground and so near that the erect ears were noted. Another example secured flew into my quarters at Empire during the evening of February 16, 1912. The two individuals secured have been compared with the type and another example from Venezuela and found to agree essentially with them. A dry skin is darker than the Venezuela specimens, but in all probability merely represents a darker color phase.

Specimens examined: Empire, 2.

Family PHYLLOSTOMIDAE. Leaf-nosed Bats

By far the greater number of American bats are comprised in this rather heterogeneous family under which a number of subfamilies are recognized. The family includes the largest of American bats, but the range in size is extraordinary, some of the species being very small. The members are usually distinguishable by the presence of "nose leaves" or naked cutaneous folds which rise prominently over the nostrils, but in the *Chilonycterinæ* these are absent. The ears, moderately developed in most genera, are variable in form, but usually rather narrow and tending to be pointed; in certain members of the family, as *Vampyrus* and *Lonchorina,* however, they are greatly elongated. The tail is also variable in length, but except in such examples as *Macrophyllum, Lonchorina,* and *Chilonycteris* does

not extend far into the interfemoral membrane; in various genera no external tail is discernible and its absence may be associated with a deep emargination of the posterior border of the interfemoral membrane. Among structural details distinguishing the family are the presence of three completely ossified phalanges in the third finger and the entire premaxilla. The molar teeth are well developed, but exhibit wide diversity of form in the various subfamily divisions.

Subfamily CHILONYCTERINAE

Genus CHILONYCTERIS Gray

Unlike most members of the family, Phyllostomidæ, the genus *Chilonycteris* lacks a nose leaf and the well-developed tail projects through and overlaps the upper surface of the interfemoral membrane. The ears are long with pointed tips directed slightly backward. The braincase is subglobose, owing largely to the very narrow interorbital constriction. The rostrum is depressed above near base, and somewhat upturned anteriorly, the nasal opening circular and directed forward. The teeth are 34 in number.

CHILONYCTERIS RUBIGINOSA RUBIGINOSA Wagner

Dark Brown Bat

Chilonycteris rubiginosa WAGNER, Weigmann's Arch. f. Naturg., IX, Vol. 1, p. 367. Type from Caiçara, Matto Grosso, Brazil.

In general color this bat is dark brown, or warm sepia (Ridgway, 1912). The pelage is rather long and directed forward over the



FIG. 4.—Chilonycteris rubiginosa rubiginosa. No. 179754, U. S. Nat. Mus. About nat. size.

head from a hair-whorl on the back of the neck. The face is well haired and elongated tufts project from the sides of the muzzle. The forearm measures about 62 millimeters. Typical *Chilonycteris rubiginosa* is replaced in southern Mexico by the smaller form, *C. r. mexicana*.

Specimens collected by August Busck in the Chilibrillo caves, near Alhajuela, in April or May, 1911, have been recorded by G. S. Miller, Jr. (1912, p. 23); examples from the same place are recorded by

Anthony (1916, p. 373). A few were found by me January 30, 1912, in one of the larger caves of the same series in which Mr. Busck and Mr. Anthony obtained their specimens. They were located near the entrance and seemed rather shy and quick to leave cavities near the roof in which they were resting. Twenty-three were shot, along with a large number of *Hemiderma perspicillatum aztecum*, in a French diversion tunnel near Bas Obispo, January 27, 1912. Here they left the high-vaulted roof and began flying back and forth, in company with the more abundant species, as soon as my boat entered the dimly lighted tunnel which was driven through a hill to turn aside the flow of a small river.

Specimens examined: Bas Obispo, 23; Rio Chilibrillo (Chilibrillo caves), 25[1]; Vijia, 2.

Subfamily PHYLLOSTOMINAE

Genus MICRONYCTERIS Gray

The members of the genus *Micronycteris* are small, slenderly formed bats with very large, thin, papery interfemoral membrane. The thin delicate ears are variable in size and are connected by a concealed band across the forehead. The long pelage of upperparts is rusty brownish in color, becoming white basally; rather long hairs cover the lower inner sides and conspicuously fringe the anterior margins of the ears. Similar in structure and external appearance to *Macrophyllum*, but hind limbs shorter; interfemoral membrane similarly extensive, but perforated by the short tail for about half its expanse instead of to near the posterior border as in *Macrophyllum*; color rusty instead of dark brownish; nose leaf prominent, but much narrower than in *Macrophyllum*. Skull much more slender than that of *Macrophyllum*, the anterior nares opening upward as well as forward close behind the base of the incisors. Dentition much as in *Macrophyllum*, but premolars all well developed. The teeth are 34 in number.

MICRONYCTERIS MICROTIS Miller

Nicaraguan Small-eared Bat

Micronycteris microtis MILLER, Proc. Acad. Nat. Sci., Philadelphia, p. 328, July 27, 1898. Type from Greytown, Nicaragua.

The ears of this bat can be regarded as small only when contrasted with those of its large-eared congener *Micronycteris megalotis*. The species is rusty brown in general color. The ears when laid forward

[1] Six in collection Amer. Mus. Nat. Hist.

reach just beyond the muzzle. The forearm measures about 32 millimeters.

The small number of specimens of *Micronycteris* available from Panama are referred to this form, whose exact relationship to the larger-eared but otherwise similar form *M. megalotis* of South America and *M. m. mexicana* of Mexico is not very clear. The ears in these specimens are short but rather variable in width and



FIG. 5.—Micronycteris microtis.
No. 198338, U. S. Nat. Mus. About nat. size.

the skulls, with one exception, are about like those of *M. megalotis* and *M. m. mexicana*. A single individual, apparently like the others externally, has a skull so small that I doubtfully refer it to the same species. This aberrant specimen was collected by R. E. B. McKenney at Bocas del Toro, whence additional material is, therefore, especially desirable.

M. microtis ranges in Panama from sea level well up on the slopes of the mountains. An example was taken at Boquete on the southern slope of the Volcan de Chiriqui by W. R. Maxon. In a note accompanying specimens from Pinogana, at sea level in the Darien region, H. Pittier says: "A fire was made at the base of a hollow tree showing signs of being inhabited. Unfortunately all the bats fell in the fire, so that only two could be saved."

Specimens examined: Bocas del Toro, 1; Boquete, 1; Pinogana, 2.

Genus LONCHORINA Tomes

The very long nose leaf and large ears are among the external characters distinctive of the genus *Lonchorina*. The elongated posterior limbs, and tail reaching posterior border of large interfemoral membrane, approximate the arrangement of these parts in *Macrophyllum*. The skull and teeth, however, somewhat suggest those of *Chilonycteris* with differential details. The interorbital region is deeply depressed on the median line, the nasals, curving upward and over anteriorly, project above the nasal opening; the molars are similar to those of *Chilonycteris* in general sculpture, the anterior upper premolars are more reduced in size, and the median lower premolars are relatively small as in that genus. The teeth are 34 in number.

LONCHORINA AURITA Tomes

Tomes' Long-eared Bat

Lonchorina aurita Tomes, Proc. Zool. Soc. London, 1863, p. 83. Type from West Indies.

The distinguishing characters of the species have been given under the genus. The forearm measures about 53 millimeters.

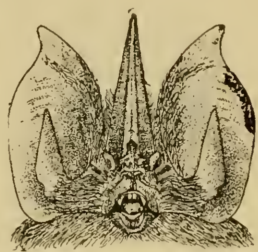


Fig. 6.—Lonchorina aurita.
No. 174904, U. S. Nat. Mus. About nat. size.

Mr. Miller (1912, p. 23) has published detailed measurements of two adults, a male and a female, collected in the Chilibrillo cave, near Alhajuela, by August Busck, April 14, 1911. Mr. Busck obtained five additional specimens at the same locality in March, 1912. The species is mainly West Indian in known distribution and has not been recorded from elsewhere in Middle America.

Specimens examined: Rio Chilibrillo (Chilibrillo cave near Alhajuela), 7.

Genus TONATIA Gray

In general external characters *Tonatia* is similar to *Micronycteris,* but the single species known to occur in Panama is decidedly larger (forearm about 53 mm.) than the regional representative of the latter genus (forearm about 32 mm.). The skull is more massive in general structure, but has a narrower palate and more constricted interorbital region than *Micronycteris.* More important differential characters are exhibited by the teeth. The upper canines are relatively larger and nearly in contact with the median incisors, thus forcing the outer incisors out of line; the large lower canines meet behind the incisors, which are reduced to two in number; the median lower premolar is obsolescent, its crown reaching about the level of the anterior premolar, instead of being a well-developed functional tooth as in *Micronycteris.* The teeth are 32 in number.

TONATIA AMBLYOTIS (Wagner)

Round-eared Bat

Phyllostoma amblyotis WAGNER, Wiegmann's Archiv. f. Naturg., p. 365, 1843. Type from Matto Grosso, Brazil.

Characters distinguishing the round-eared bat from the other species of the region are given under the genus. The forearm measures about 53 millimeters.

The only record I have of its occurrence in Panama, or any part of Middle America, is that of Thomas (1902*a*, p. 54) based on specimens collected at Bugaba, Chiriqui, by H. J. Watson. The species is said to be rare.

Genus MACROPHYLLUM Gray

The unusual elongation of the hind limbs and corresponding posterior extension of the interfemoral membrane inclosing the long tail to border, together with the large nose leaf and slender general form externally distinguish this monotypic genus. The skull is short with high, anteriorly arched braincase and very short, broad rostrum. The nasal opening is directed forward from a point far back leaving a shelf-like projection of the jaw between the opening and the base of the incisors. The dentition is similar to that of *Micronycteris,* but the anterior upper premolar is very small and the middle lower premolar notably minute, crowded inward out of line and nearly hidden by the other premolars. The reduced condition of these teeth is probably associated with the general shortness of the skull. The upper incisors completely fill the space between the canines, the middle pair being much larger than the outer, with somewhat oblique cutting edges. The teeth are 34 in number.

MACROPHYLLUM MACROPHYLLUM (Wied)

Long-legged Bat

Phyllostoma macrophyllum WIED, Beitr. zur Naturg. Brasilien, Vol. 2, 1826, p. 188. Type from Mucuri River, Minas Geræs, Brazil.

Features distinctive of this rare bat have been given under the genus. The forearm measures about 38 mm. The only record of the occurrence of the species in Panama or any part of Middle America is that recently published by E. W. Nelson (1912, p. 93), based on specimens taken by me in the ruins of old Panama about five miles east of the modern city. Accompanied by W. H. Osgood I visited the ruins February 7, 1912. On entering a vaulted cellar

behind one of the principal ruins along the beach path a short distance west of the old church tower we found ourselves in the midst of a large colony of *Hemiderma perspicillatum aztecum* and a smaller colony of *Glossophaga soricina leachii*, many individuals of the mingled species fluttering close about our heads. Among a few specimens of the common species knocked down we discovered a *Macrophyllum* and immediately began searching the flying swarm



Fig. 7.—Macrophyllum macrophyllum.
No. 179724, U. S. Nat. Mus. About nat. size.

about us for others. We soon learned to distinguish the rare species from the common ones by the long hind limbs and corresponding posterior extension of the interfemoral membrane. Six specimens, altogether, were secured, three of which are in the U. S. National Museum and the others, collected by Mr. Osgood, are in the Field Museum of Natural History. No material from the type region of the species is available for comparison, but the specimens agree closely with the published descriptions and are assumed to represent the monotypic genus.

Specimens examined: Old Panama, 6.

Genus PHYLLOSTOMUS Lacépède

The distinguishing features of the members of this genus are the large robust form, well-developed nose leaf, rather small, narrow, pointed ears, short tail and large interfemoral membrane combined with short, massive skull and the possession of two lower incisors and two lower premolars on each side. There are no facial stripes. The skull in general angularity, especially the prominent sagittal crest and outstanding paroccipital processes suggests that of *Vampyrus*, but the much shorter rostrum exceeds the interorbital area in width, the teeth differ notably in structure and the lower premolars in number. The teeth are 32 in number.

PHYLLOSTOMUS HASTATUS PANAMENSIS Allen

Panama Spear-nosed Bat

Phyllostomus hastatus panamensis ALLEN, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 233, June 29, 1904. Type from Boqueron, Chiriqui, Panama.

With the exception of the false vampire (*Vampyrus spectrum*) this is the largest American bat. The forearm measures about 90 millimeters. It is a robust animal, very dark brown or blackish brown in color above, except a lighter brown area across the shoulders. A gland on the under side of the neck is conspicuous in the males, but rudimentary in the females.



FIG. 8.—Phyllostomus nastatus panamensis.
No. 179732, U. S. Nat. Mus. About nat. size.

The Panama race apparently differs from *Phyllostomus hastatus hastatus*[1] of Trinidad and eastern Venezuela in larger size. Specimens from Panama and as far north as Patuca, Honduras, are, however, equalled by examples from the Amazon and from southern Brazil.[2]

Common, at least at low elevations, throughout Panama. In one of the Chilibrillo caves, near Alhajuela, I found thousands suspended from various parts of the vaulted roof in the total darkness of the principal chamber. More than 100 were seen in a single spot over which they were so densely massed that their bodies seemed to be touching. There was much loud squeaking, but I was allowed to approach to within 12 or 15 feet when they vacated the place almost in a body. In flying through the resounding passages of the cave the noise of their wings resembled the thunderous roar of a heavy

[1] Type region fixed as Surinam by Allen, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 233-234, June 29, 1904.

[2] *Phyllostomus hastatus caucæ* Allen measures about the same and seems otherwise indistinguishable from *P. h. panamensis* which was given page priority when the two were published.

waterfall when heard at a distance. The cave contained several tons of guano, mainly the product of this species. Several smaller colonies of these bats were encountered in neighboring caves.

An aggregation of perhaps 100 of the same species was located in a small cave on the rocky sea shore a short distance west of the Pacific entrance to the Panama Canal at Balboa. Here the bats were clinging in clusters in dimly lighted cavities from which, when dislodged by shooting, some fell into the sea. One of the latter, bobbing about in the rough water, was only partially disabled as I learned when, on reaching for it from a boat, a canine tooth was instantly driven through the middle of the nail of my index finger. In other parts of the same cave were a few *Hemiderma perspicillatum aztecum* and *Glossophaga soricina leachii*.

The original description of the Panama form by Dr. Allen (*l. c.*) was based on six specimens from Boqueron, western Panama. Under the name *Phyllostomus hastatus* Mr. Miller (1912) has published detailed measurements of an adult male collected at Cabina by August Busck. Anthony (1916, p. 373) records examples from Boca de Cupe, Capeti, Real de Santa Maria and Rio Chilibrillo. Mr. Alston (1879, p. 42) has shown how this species has shared with *Vampyrus spectrum* the false accusation of being a blood sucker, the real culprits being the true vampires, *Desmodus* and other genera.

Specimens examined: Balboa, 20; Boca de Cupe, 4[1]; Boqueron, 6[1]; Cabima, 1; Capeti, 4[1]; Panama (city), 1; Real de Santa Maria, 8[1]; Rio Chilibrillo (Chilibrillo cave, near Alhajuela), 42.[2]

Genus TRACHOPS Gray

In the genus *Trachops* the lips and chin are conspicuously studded with conical or cylindrical wart-like protuberances, which distinguish it at a glance. The short tail projects from the large interfemoral membrane. The skull in general form is somewhat similar to that of *Vampyrus,* but less angular. The median lower premolars are very small and crowded inward out of line much as in *Macrophyllum.* The teeth are 34 in number.

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[1] Collection Amer. Mus. Nat. Hist.

[2] Nine in collection Amer. Mus. Nat. Hist.

TRACHOPS CIRRHOSUS (Spix)

Fringe-lipped Bat

Vampyrus cirrhosus Spix, Simiar. et Vespert. Brasil, 1823, p. 64, pl. 36, fig. 3. Type from Brazil.

The fringe-lipped bat is large, dark-colored, and has large ears. The peculiar condition of the lips and chin have been described under the genus. The forearm measures about 62.5 millimeters.

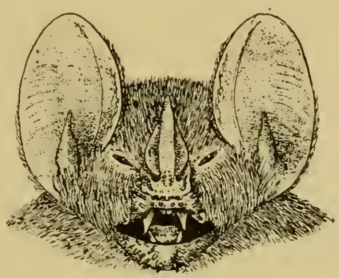


Fig. 9.—Trachops cirrhosus.
No. 174884, U. S. Nat. Mus. About nat. size.

A specimen of this species was taken by August Busck in the Chilibrillo cave near Alhajuela, in March, 1912.

Specimens examined: Rio Chilibrillo (Chilibrillo cave), 1.

Genus VAMPYRUS Leach

Very large general size, the forearm over 100 millimeters or four and one-fourth inches long and wing expanse about 760 millimeters or two and one-half feet, alone distinguishes the genus *Vampyrus* among American bats. The ears are long, relatively narrow and round-pointed, and the interfemoral membrane is large, but there is no external tail. In the form of the braincase the skull closely resembles that of *Phyllostomus*, but the sagittal crest is much higher and projects farther posteriorly; the rostrum and mandible are much longer; the latter affording space for an additional premolar; the nasal opening is slightly extended backward by a V-shaped emargination. Dental peculiarities are numerous, including the deep emargination of the lateral borders of the first and second upper molars, owing to displacement inward or greatly reduced size of mesostyle. The teeth are 34 in number.

VAMPYRUS SPECTRUM NELSONI Goldman

Nelson's False Vampire Bat

Vampyrus spectrum nelsoni GOLDMAN, Proc. Biol. Soc. Washington, Vol. 30, p. 115, May 23, 1917. Type from Coatzacoalcos, Vera Cruz, Mexico.

Nelson's false vampire, the largest North American bat, differs from the typical form of South America in somewhat smaller size and cranial details, especially the reduction of the hypocone of the posterior upper premolar. It is reddish-brown in color.

The general range of the species is from the Amazonian region northward through Middle America to southern Mexico. In Middle America it seems to be much less abundant than farther south, or at



FIG. 10.—Vampyrus spectrum nelsoni.
No. 78127, U. S. Nat. Mus. About nat. size.

least few examples from that region have found their way into museum collections. A very large bat that I saw one evening in rather slow butterfly-like flight along the bank of the Chagres at Alhajuela I took to be of this species, but throughout the period covered by my work in Panama I was unsuccessful in securing specimens. Alston (1879, p. 39) notes the species collected in Panama by McLeannan, probably at some point along the line of the Panama railroad. More recently (Allen, 1904, p. 78) has recorded a pair taken by J. H. Batty at Boqueron in western Panama.

This bat, now known to be harmless, was formerly believed to be a bloodsucker, and the unfortunate name attached to it, together with its large size and repugnant general appearance, have doubtless fostered this misconception of its real character. The true vampires belong to the genera *Desmodus, Diphylla* and *Diaemus* which constitute a separate family, the *Desmodontidæ*. The false vampire

is so little known in Middle America that the observations of Bates,[1] made at Ega on the upper Amazon many years ago seem worth quoting. He says: "The vampire was here by far the most abundant of the family of leaf-nosed bats. . . . . Nothing in animal physiognomy can be more hideous than the countenance of this creature when viewed from the front; the large leathery ears standing out from the sides and top of the head, the erect spear-shaped appendage on the tip of the nose, the grin and the glistening black eye all combining to make up a figure that reminds one of some mocking imp of fable. No wonder that imaginative people have inferred diabolical instincts on the part of so ugly an animal. The vampire, however, is the most harmless of all bats, and its inoffensive character is well known to residents on the banks of the Amazon." He found that the church at Ega was the headquarters of these bats and adds: "I used to see them, as I sat at my door during the short evening twilights, trooping forth by scores from a large open window at the back of the altar, twittering cheerfully as they sped off to the borders of the forest. They sometimes enter houses; the first time I saw one in my chamber, wheeling heavily round and round, I mistook it for a pigeon, thinking that a tame one had escaped from the premises of one of my neighbors. I opened the stomachs of several of these bats, and found them to contain a mass of pulp and seeds of fruits, mingled with a few remains of insects." The insects were species of Coleoptera.

Specimens examined: Boqueron, 2.[2]

Subfamily GLOSSOPHAGINAE

Genus GLOSSOPHAGA Geoffroy

The genus *Glossophaga* typifies the subfamily *Glossophaginæ* which includes six other genera, mainly tropical in distribution. The members of the group are small bats characterized externally by elongated muzzle, small nose leaf, short, rounded ears, notched lower lip, and short tail protruding slightly from the upper side of the moderately developed interfemoral membrane. In external appearance *Glossophaga* bears a striking resemblance to *Lonchophylla,* a member of the same subfamily, and accurate determinations must be based on the examination of skulls. The skull is shorter than in *Lonchophylla,* and differs most notably in the possession of complete zygomata. The median upper incisors are about as wide as high, and

[1] The Naturalist on the River Amazons, Vol. 2, pp. 332-333, 1863.

[2] Collection Amer. Mus. Nat. Hist.

project less prominently forward than in *Lonchophylla*. The teeth are 34 in number.

GLOSSOPHAGA SORICINA LEACHII (Gray)

Leach's Long-tongued Bat

Monophyllus leachii Gray, Voyage of the *Sulphur*, Zool., Vol. 1, p. 18, 1844. Type from Realejo, Nicaragua.

As may be inferred from the remarks on the genus, Leach's long-tongued bat closely resembles species of *Lonchophylla*. It most closely approaches *Lonchophylla concava* in appearance, the dark brown color and proportions being nearly identical, but the ears are slightly more rounded, the forearm slightly longer and the lower, less protruding upper incisors also aid in its determination. The length of the forearm is about 35 millimeters.

In point of numbers *Glossophaga soricina leachii* seems to be exceeded in Panama only by *Hemiderma perspicillatum aztecum*. It passes the day in similar situations, often resting in close proximity to the latter species in tunnels, caves, or other darkened places, but smaller colonies seem to be the rule.



Fig. 11.—Glossophaga soricina leachii. No. 179871, U. S. Nat. Mus. About nat. size.

At Corozal a few were located in a partly dark tunnel roofed with smooth concrete. The tunnel received daylight at both ends and the bats could be clearly seen by looking toward the light. They were irregularly distributed, one only in a place, clinging by their claws to the edges of roughened spots in the concrete, some with their bodies swinging free from the middle of the roof, but most of them on the side walls or in corners, their stomachs lying against the concrete and their nose leaves standing out rather conspicuously at right angles. All were females and several carried a small young attached to a teat. The same tunnel was inhabited by *Hemiderma p. aztecum*.

In a half-dark cellar behind a prominent ruin a short distance west of the cathedral tower at the old city of Panama, W. H. Osgood and I found these bats very near neighbors of *Hemiderma p. aztecum*

and the exceedingly rare species *Macrophyllum macrophyllum*. They were clinging singly in the vicinity of massed clusters of the *Hemiderma*. We were allowed to approach quite near, the bats watching us suspiciously, their frequent squeaks and quivering ears showing their alertness. One was seen to extend its long tongue the full length and then retract it much as a dog does when stretching.

Small colonies were located in two shallow caves along the rocky coast a short distance west of the Pacific entrance to the Panama Canal. In these caves scattered individuals were hanging along crevices in half-lighted places. One cave was shared with *Phyllostomus hastatus panamensis* and *Hemiderma p. aztecum*, the other with the *Hemiderma* and *Saccopteryx bilineata*. Others were clinging to the roof of a limestone cave on the mountain side several miles below the Darien gold mines at Cana. In other parts of the same cave were colonies of *Hemiderma p. aztecum*, *Hemiderma castaneum*, *Lonchophylla robusta*, *Lonchophylla concava* and *Desmodus rotundus murinus*.

At Bohio a few of these bats were suspended from the vaulted roof of the old French powder house. At Porto Bello several individuals were located in a dark corner of an old Spanish fort.

As *Glossophaga soricina*, 13 specimens from Boqueron, collected by J. H. Batty, have been recorded by Allen (1904, p. 78). Under the same name, Bangs (1902, p. 50) listed a specimen collected by W. W. Brown, Jr., at Bugaba. Thomas (1903*a*, p. 39) in recording examples from small islands off the coast of western Panama, lists the following localities: Gobernador, Insolita, Jicaron, Palenque, Brava, Parida, Boqueron (island), and Cebaco.

In a recent revision of the genus, Miller (1913*a*, p. 419) lists specimens examined from the following localities in Panama: Balboa, Canal Zone, Colon, and Paraiso.

The feeding habits of this bat are little known, but are probably similar to those of a Glossophagine species, of Jamaica, which were described in considerable detail by W. Osburn[1] many years ago. His interesting account well illustrates the manner of using the very long protractile tongue in licking away the juice and pulp of soft fruits.

Specimens examined: Agua Clara, 1; Ancon, 1; Balboa, 3; Bohio, 3; Boqueron, 32[2]; Bugaba, 1[3]; Cana, 1; Colon, 3; Corozal, 24; Empire, 1; Old Panama, 16; Panama (city), 37[1]; Paraiso, 44; Porto Bello, 1; San Pablo, 12; Vigia, 1.

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[1] Proc. Zool. Soc. Lond., 1865, pp. 81-85.

[2] Collection Amer. Mus. Nat. Hist.

[3] Collection Mus. Comp. Zool.

Genus LONCHOPHYLLA Thomas

The striking external resemblance of *Lonchophylla* to *Glossophaga* has been pointed out in remarks on that genus. The skull is longer and easily distinguishable from that of *Glossophaga,* by the incomplete zygomatic arch, and the differing form of the incisors, the upper median pair being relatively narrower, higher and more projecting forward, and the lower series having trifid cutting edges. The teeth are 34 in number. Two species inhabit the region under review.

LONCHOPHYLLA ROBUSTA Miller

Rusty Long-tongued Bat

[Plate 37, figs. 5, 5*a*]

Lonchophylla robusta Miller, Proc. U. S. Nat. Mus., Vol. 42, No. 1882, p. 23, March 6, 1912. Type from cave on Chilibrillo River, Panama.

The rusty color and large size distinguish *Lonchophylla robusta* from the other Glossophagine bats known to inhabit Panama. The forearm measures about 45 millimeters.



Fig. 12.—Lonchophylla robusta.
No. 179847, U. S. Nat. Mus. About nat. size.

The species was first collected by August Busck in a cave on the Chilibrillo River near Alhajuela, in 1911. In the following year specimens were obtained by me in a limestone cave at about 2,000 feet altitude on the slope of the Pirre Mountains near Cana. The same cave was inhabited by *Lonchophylla concava, Glossophaga soricina leachii, Hemiderma perspicillatum aztecum, Hemiderma castaneum* and *Desmodus rotundus murinus.*

Lonchophylla robusta approaches the much smaller species *L. mordax* Thomas in the more important cranial and dental details and departs widely from its large congener *L. hesperia* G. M. Allen. No close comparison with *L. concava,* the only other species of the genus known to occur in Panama, is necessary.

Specimens examined: Cana, 6; Chilibrillo River (Chilibrillo cave near Alhajuela), 4 (including type).

LONCHOPHYLLA CONCAVA Goldman

Panama Long-tongued Bat

[Plate 37, figs. 5, 5*a*]

Lonchophylla concava GOLDMAN, Smiths. Misc. Coll., Vol. 63, No. 5, p. 2, March 14, 1914. Type from Cana, eastern Panama (altitude 2,000 feet).

In size, color and general external appearance *Lonchophylla concava* very closely resembles *Glossophaga soricina leachii* and examination of the skull is necessary to determine it with certainty. The ears are more pointed, however, and the longer more protruding upper incisors may distinguish it from the *Glossophaga* in specimens with the skulls in place. The forearm of the type measures 33.9 millimeters.

A single specimen of this species was obtained in a limestone cave at about 2,000 feet altitude on the slope of the Pirre Mountains near Cana. The cave was also inhabited by *Lonchophylla robusta, Glossophaga soricina leachii, Hemiderma perspicillatum aztecum, Hemiderma castaneum,* and *Desmodus robustus murinus.* Owing to the remarkable resemblance to *Glossophaga s. leachii* the specimen was at first referred to that species.

In the general form of the skull *L. concava* closely approaches *L. mordax* Thomas, the type species of the genus, and exhibits a corresponding departure from *L. hesperia* G. M. Allen in which the skull is relatively much narrower and more elongated. The greater attenuation of the rostrum in *L. hesperia* leaves the third upper molar implanted well in front of the maxillary processes of the zygoma as in the genus *Chœronycteris,* instead of in the same horizontal plane with these processes as in *L. mordax.* On the other hand *L. concava* approaches *L. hesperia* in the narrowness of the second upper premolar, the conspicuous inner lobe present in *L. mordax* being reduced to a slight swelling bearing a small cusp. The aberrant character of *L. hesperia* has been pointed out by Miller (1912, p. 24) who remarks: "The animal is so different from the other known forms of *Lonchophylla* that it can hardly be regarded as a member of the same genus." Although widely different from *L. hesperia, L. concava* combines characters which tend to bridge the gap between that species and the more typical forms of the genus.

Specimens examined: One, the type.

Subfamily HEMIDERMINAE

Genus HEMIDERMA Gervais

The bats of this genus are small or medium-sized species with small nose leaves, rather short, somewhat pointed ears and tails reaching to about the middle of the naked, moderately developed inter-

femoral membrane. . The forearm is distinctly furred along outer side near base. No facial stripes are present. The skull is massive, with short rostrum and moderately developed sagittal crest; in the incomplete zygomatic arches it resembles that of *Lonchophylla,* but differs widely in other respects. The teeth are 32 in number.

HEMIDERMA PERSPICILLATUM AZTECUM (Saussure)

Short-tailed Bat

Carollia azteca SAUSSURE, Rev. et Mag. Zool., Ser. 2, Vol. 12, pl. 20, fig. 1, p. 480, 1860. Type from southern Mexico.

The short-tailed bat is robust, medium sized, and has rather large feet. It varies from dark brown to rusty in color. The forearm measures about 42 millimeters. A much rarer species, *Hemiderma castaneum,* sometimes inhabiting the same places, is distinguished by smaller size, the forearm being about 5 millimeters shorter.



FIG. 13.—Hemiderma perspicillatum aztecum
No. 179811, U. S. Nat. Mus. About nat. size.

Hemiderma p. aztecum is the bat most frequently met with in Panama. Numbers may be found resting during the day in almost any dark sheltered places, such as caves, tunnels, or the darkened corners of old buildings.

Near Bas Obispo a colony of several thousand short-tailed bats was located in a tunnel driven by the French for the diversion of a small river. Here they hung in massed clusters from hollowed places in the rock roof about 15 feet above the water. Near the entrances to the same tunnel were smaller numbers of *Chilonycteris rubiginosa.*

At Corozal these bats were associated with *Glossophaga soricina leachii* in a half-dark concrete tunnel roofed squarely over. They were attached to roughened places in the concrete, their bodies in contact with the wall, and their heads turned partly outward.

Following directions given me by Col. D. D. Gailliard, and accompanied by W. H. Osgood, I visited the ruins of old Panama in quest of bats February 7, 1912. We entered a vaulted cellar behind high walls overgrown with wild fig trees near the beach path a short dis-

tance west of the old cathedral tower and found a large colony of *H. p. aztecum* suspended in masses from the ceiling. These bats shared the cellar with a smaller colony of *Glossophaga s. leachii* and a few individuals of *Macrophyllum macrophyllum,* which on being disturbed became mingled and fluttered close about us squeaking incessantly. When we remained quiet a few minutes many of the bats resumed their resting places, quietly attaching themselves only a few feet away. The short-tailed bats clung with heads twisting about, watchful eyes upon us, and ears trembling or turning nervously this way and that.

Another large colony was located in an old powder house on the bank of the Cascajal River about five miles above Porto Bello. Here the bats hung in apparently solid clusters from the ceiling of a half-darkened room.

At Bohio a few were detected clinging heads downward in half-darkness along the ridge pole of an abandoned palm-thatched house. When the door was opened and more light admitted they worked their way along the pole by short shuffling steps, into a darker corner where several disappeared in a crevice.

In the Chilibrillo caves near Alhajuela, whence a specimen has been recorded by Miller (1912, p. 25), a few were found by me roosting in the total darkness of the same large interior chamber occupied by a huge colony of *Phyllostomus hastatus panamensis,* but they were restricted to shallow cavities in the lower side walls while the *Phyllostomus* was massed on the walls and roof above them. Anthony (1916, p. 374), however, lists this form as the "most abundant bat of the caves." Besides the Rio Chilibrillo specimen he records specimens from El Real, Tacarcuna and Tapalisa.

These bats were clustered in shallow crevices of two small caves in the bluff forming the coast line a short distance west of the Pacific entrance to the Panama Canal at Balboa. One of these caves was also inhabited by *Phyllostomus h. panamensis* and *Glossophaga s. leachii,* and the other by *Glossophaga s. leachii* and *Saccopteryx bilineata.*

My quarters in an old French building at Empire were shared with these bats, numbers of which seemed to come tumbling out of crevices in the upper story just at dusk every evening. Near the same locality a few spent the day attached so that their bodies hung free in a rather well-lighted place under a railroad bridge.

They are common in most of the caves and old tunnels in the vicinity of the Darien gold mines at Cana; a limestone cave close to

the railroad line several miles below the mines contains hundreds during the day, and is also inhabited by *Desmodus rotundus murinus, Glossophaga soricina leachii, Lonchophylla robusta, Lonchophylla concava* and *Hemiderma castaneum.*

Specimens collected by W. W. Brown, Jr., on San Miguel Island and at Bugaba, Chiriqui, have been recorded by Bangs (1901, p. 644, 1902, p. 50) who remarks that the series of 13 specimens from the latter locality "presents a wide range in the color of the upper parts, varying from hair-brown to russet, with every intermediate shade." Seventeen specimens obtained at Boqueron by J. H. Batty are listed by Allen (1904, p. 78). Examples taken by the same collector are recorded by Thomas (1903*a*, p. 39) from the following small islands off the south coast of western Panama; Sevilla, Jicaron, Gobernador, Brava, Insolita, and Cebaco. Hahn (1907) in his revision of the genus, published records of specimens examined by him from Panama (city), Boqueron, and Colon. Seven examples from Panama (city), as shown by Hahn (1907, p. 112) had been erroneously assigned by Bangs (1906, p. 213) to *Hemiderma castaneum.*

Specimens examined: Balboa, 1; Bas Obispo, 12; Boqueron, 3[1]; Bugaba, 13[2]; Cana, 23; Corozal, 13; Empire, 8; Old Panama, 20; Panama (city), 9[2]; Porto Bello, 6; Real de Santa Maria, 1[1]; Rio Chilibrillo (Chilibrillo cave, near Alhajuela), 10[3]; Rio Trinidad (Agua Clara), 4; Rio Indio, 1; San Miguel Island, 1; Tacarcuna, 4[1]; Tapalisa, 1.[1]

HEMIDERMA CASTANEUM (H. Allen)

Chestnut Short-tailed Bat

Carollia castanea H. ALLEN, Proc. Amer. Philos. Soc., Vol. 18, p. 19, February 25, 1890. Type from Costa Rica.

The chestnut short-tailed bat resembles *Hemiderma perspicillatum aztecum* very closely, but is distinguished by smaller size, the forearm measuring about 37 millimeters instead of about 42 millimeters, as in the latter species. The difference in size seems still more apparent when skulls of the two species are compared. The smaller *Hemiderma* is rare while the larger is probably the most abundant bat throughout the region under consideration.

In a limestone cave at about 1,500 feet altitude on the mountain side near Cana two of these bats were knocked down along with numerous examples of *Hemiderma p. aztecum.* Although they occu-

[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Mus. Comp. Zool.
[3] Five in collection Amer. Mus. Nat. Hist.

pied the same cave and are indistinguishable from the latter species in color their specific distinctness seems clear. They agree with the type from Costa Rica in decidedly smaller size, as compared with *H. p. aztecum.* Others were found inhabiting the tunnel of an old mine at 2,000 feet near Cana.

Under the name *Hemiderma castaneum* seven specimens collected by W. W. Brown, Jr., at Calidonia, near Panama, were recorded by Bangs (1906, p. 213). Hahn (1907, p. 112), in reviewing the group, has shown that these specimens were erroneously identified; they are referred by him to *H. p. aztecum.* The type of *H. castaneum* has, therefore, remained unique until the present time.

Specimens examined: Cana, 4.

Subfamily STURNIRINAE

Genus STURNIRA Gray

Owing to peculiar and highly specialized tooth structure the genus *Sturnira* has been placed in a separate subfamily. Externally it is not very unlike some of the other Phyllostomidæ, one of the best distinguishing characters being the conspicuous tufts of stiff yellowish or rusty reddish hairs present in males near the front of the shoulder. There are no facial stripes. The nose leaf is small and the ears short and pointed. There is no external tail and the calcar is very small. The interfemoral membrane is reduced to a narrow fringe densely furred to the margin. The toes are haired to the base of the claws. In general form the skull resembles those of *Vampyressa* and *Vampyrops,* but the dentition is widely different. A cranial feature shared with *Vampyressa* is the extension of the nasal opening backward at the expense of the nasals. The teeth are 32 in number.

STURNIRA LILIUM PARVIDENS Goldman

Northern Yellow-shouldered Bat

Sturnira lilium parvidens Goldman, Proc. Biol. Soc. Washington, Vol. 30, p. 116, May 23, 1917. Type from Papayo (about 25 miles northwest of Acapulco), Guerrero, Mexico.

The distinguishing characters of the yellow-shouldered bat in Panama are the same as those of the genus. The dark tips of the pelage give the back a dark brown tone, but the under color of the fur is gray. The forearm measures about 44 millimeters.

This bat has been accorded a range as a species from Paraguay, where it was observed by Azara, north to Mexico. It is one of the rarer ones in collections, and the only record from Panama is that of



Fig. 14.—Sturnira lilium parvidens.
No. 8209, U. S. Nat. Mus. About nat. size.

Bangs (1902, p. 51) of a single specimen taken at 7,500 feet on the Volcan de Chiriqui by W. W. Brown, Jr. The specimen exhibits the narrow braincase and molars characterizing the northern subspecies.

Specimens examined: Volcan de Chiriqui, 1.[1]

Subfamily STENODERMINAE

Genus URODERMA Peters

In general appearance, including the arrangement of the white facial and dorsal stripes, *Uroderma* much resembles *Vampyrops, Vampyrodes* and *Chiroderma*. In these genera a pair of white stripes extend upward from the sides of the nose leaf to the inner base of the ears; another pair less distinct reaches from the corners of the mouth toward the ears, and a median dorsal line is usually prominent. But the single species of *Uroderma* may be distinguished by the naked or minutely haired posterior margin of the interfemoral membrane in combination with the length of the forearm (about 45 millimeters). The skull is very similar in general to that of *Vampyrops,* but is easily recognizable by the bifid upper incisors. The teeth are 32 in number.

URODERMA BILOBATUM

Yellow-eared Bat

Uroderma bilobatum Peters, Monatsber. k. Preuss. Akad. Wissensch. Berlin, p. 587, 1866. Type from São Paulo, Brazil.

Uroderma convexum Lyon, Proc. Biol. Soc. Washington, Vol. 15, p. 83, April 25, 1902. Type from Colon, Panama.

In addition to and in combination with recognition characters given under the genus the yellowish color of the ear margins of

[1] Collection Mus. Comp. Zool.

Uroderma bilobatum, distinct in fresh specimens and fading in dry skins, might be mentioned. The species ranges from southern Brazil north at least to Costa Rica.



FIG. 15.—Uroderma bilobatum.
No. 153563, U. S. Nat. Mus. About nat. size.

In the forest near Gatun *Uroderma bilobatum* was located several times, a few in a place, clinging during the day in clusters to the midribs on the under sides of large palm leaves. They usually choose darkened spots where the leaf was folded over, or overhanging pinnæ shut out much of the light.

Andersen (1908, p. 220) in a revision of the genus places *Uroderma convexum* Lyon in synonymy. Comparisons made by me seem to justify this disposition of the name. Andersen records Panama specimens from Colon, Brava Island, Cebaco Island, Jicaron Island, Insolita Island, and Gobernador Island. With the exception of Colon the same localities for specimens in the British Museum had been listed by Thomas (1903*a*, p. 40), who also questioned the validity of *Uroderma convexum* Lyon.

A specimen erroneously referred by Bangs (1901, p. 644) to *Vampyrops helleri* was collected by W. W. Brown, Jr., on San Miguel Island. The same mistake in identification applies to specimens recorded by Bangs (1902, p. 50) from Bugaba, and by Allen (1904, p. 79) from Boqueron.

Anthony (1916, p. 373) records examples from Capeti, Chepigana and Real de Santa Maria.

Specimens examined: Boqueron, 6[1]; Bugaba, 6[2]; Capeti, 7[1]; Chepigana, 1[1]; Chorrera, 4[1]; Puente de Piña (near Bocas del Toro), 3; Rio Indio (near Gatun), 15; San Miguel Island, 1.[2]

Genus VAMPYROPS Peters

The approach in outward appearance of *Vampyrops* to *Uroderma* has been referred to in the treatment of that genus. *Vampyrops* is, however, easily separable from *Uroderma* by the densely furred

[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Mus. Comp. Zool.

posterior border of the interfemoral membrane, and simple, oblique, instead of bifid, transverse cutting edge of upper incisors. The teeth are 32 in number.

VAMPYROPS HELLERI Peters

Heller's Bat

Vampyrops helleri Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, 1866, p. 392. Type from Mexico.

Vampyrops zarhinus H. Allen, Proc. Acad. Nat. Sci. Philadelphia, 1891, p. 400. Type from Bas Obispo, Canal Zone.[1]

Heller's bat is little known and its status not entirely clear, no specimens from the type region being available for comparison. But the original account applies so well to the Panama animal that its identification seems certain. *Vampyrops zarhinus,* a name also applicable to the Isthmian species, is therefore placed in synonymy.

Heller's bat has white face stripes and a white median dorsal line arranged about as in *Vampyrodes, Chiroderma* and *Uroderma.* It may usually be distinguished from the Isthmian representatives of these genera, however, by smaller size. The forearm measures about 39 millimeters. The edges of the ears are distinctly yellowish in life, as in *Uroderma bilobatum,* which it approaches in size and general appearance, but the densely furred, instead of naked, border of the interfemoral membrane is distinctive.

The species as now understood ranges from southern Mexico at least as far south as Cana in eastern Panama, where a single specimen was obtained by me near the entrance to the tunnel of an old mine. Specimens from northern Venezuela are apparently indistinguishable from Panama examples and the species probably reaches Brazil. As *Vampyrops zarhinus,* Thomas (1903*a,* p. 40) listed a specimen from Sevilla Island, off the southern coast of western Panama where it was collected by J. H. Batty. In regard to the record Mr. Thomas in a recent letter says: "The specimen is certainly what I always look upon as *zarhinus,* but not having the type for comparison I cannot be absolutely sure I am right. The skull quite agrees with examples from Ecuador and Para." Among the bats collected in Panama by August Busck were two immature males of *Vampyrops helleri* from Cabima, of which forearm measurements, 39 and 39.6 millimeters, respectively, were published by Miller (1912, p. 25).

Specimens examined: Cabima, 2; Cana, 1.

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[1] The type specimen in the Museum of Comparative Zoology bears on the label "Obispo, Panama, Hassler Expedition, 1872," and the original assignment of the species to Brazil appears to have been an error.

Genus VAMPYRODES Thomas

The genus *Vampyrodes* is very similar to the genus *Vampyrops,* but has two instead of three molars in each upper jaw, the small last molar present in the latter genus being absent. A more important character, however, is the suppression of the metacone in the second upper molar. The genus *Vampyrodes* outwardly somewhat resembles the genera *Uroderma* and *Chiroderma,* but the differences in size of the Panama representatives of these genera suffice to separate them. The teeth are 30 in number.

VAMPYRODES MAJOR G. M. Allen

San Pablo Bat

Vampyrodes major G. M. Allen, Bull. Mus. Comp. Zool., Vol. 52, No. 3, p. 38, July, 1908. Type from San Pablo, Isthmus of Panama.

Vampyrodes major is a rather large bat with a pair of broad white face stripes extending from the nose backward, one on each side, over the eye to above the ear, and with a white line extending from the top of the head down the middle of the back. Another white mark extends from near the corner of the mouth to the ear. These stripes are shared with *Uroderma bilobatum* and *Vampyrops helleri,* but the greater forearm measurement, about 55.5 millimeters, is distinctive.

V. major is known in Panama only from the type locality, a place now covered by the waters of Gatun Lake. A specimen also in the Museum of Comparative Zoology was collected at Cerro Santa Maria, Costa Rica, by C. F. Underwood, January 5, 1908, and the species may be expected to occur anywhere in the general region.

Specimens examined: San Pablo, 1 (type).[1]

Genus VAMPYRESSA Thomas

The genus *Vampyressa* includes very small species with the white facial markings of *Artibeus;* it agrees further with that genus in the absence of a dorsal stripe, but the ears are shorter and more rounded. There is no external tail and the narrow interfemoral membrane is densely furred to the margin as in *Vampyrops.* The skull is similar in general contour to that of *Vampyrops,* but the molars are reduced to two on each side above and below. As in that genus the median upper incisors are separated by a distinct gap, but the cutting edge is bifid instead of smooth. The teeth are 28 in number.

[1] Collection Mus. Comp. Zool.

VAMPYRESSA MINUTA Miller

Little Yellow-eared Bat

[Plate 37, figs. 3, 3*a*]

Vampyressa minuta Miller, Proc. U. S. Nat. Mus., Vol. 42, No. 1882, p. 25, March 6, 1912. Type from Cabima, Panama.

This recently described species bears a rather close general resemblance to some of the small forms of *Artibeus,* but is smaller than any of them. The arrangement of white facial stripes is the same—a supraorbital pair reaching upward from the nose pad to the inner sides of the ears, and the cheek stripes extending from the angle of the mouth toward the ears. The short rounded ears have yellow margins. The forearm measures about 32 millimeters.

Vampyressa minuta is very closely allied to *Vampyressa thyone* Thomas. It apparently differs from that species only in rather slight cranial details as shown by comparison with an Ecuadorean specimen which has been determined as *V. thyone* by Thomas. The skull is slightly smaller, the difference in size being most noticeable in the braincase. The nasals are less developed anteriorly between the maxillae, the resulting gap or rounded excision constituting a distinct posterior extension of the anterior nares. The palate seems relatively narrower behind the posterior molars. The dentition is about the same.

The type was collected at Cabima by August Busck in May, 1911. The only other known specimen flew into my room at Cana where it was captured during the evening of June 6, 1912. The bright, yellow edges of the ears and tragus attracted my attention at once. This color, most intense on the lower part of the ears, was somewhat duller toward the tips. It is still shown in the dry skin, but is much less conspicuous than when fresh.

Specimens examined: Cabima, 1 (type) ; Cana, 1.

Genus CHIRODERMA Peters

The alliance of the genus *Chiroderma* seems to be most nearly with *Vampyrops* which it resembles in external markings ; but the nose leaf is broader and the forearm and interfemoral membrane are more heavily furred than in that genus. The skull is similar to those of *Vampyrops* and *Vampyressa,* the dental formula being the same, but the teeth differ in detail. A striking contrast is presented, however, by the apparent absence of nasals, their excision foreshadowed in *Vampyressa* having progressed to the extreme degree. The teeth are 28 in number.

CHIRODERMA ISTHMICUM Miller

Isthmian Bat

[Plate 37, figs. 2, 2*a*]

Chiroderma isthmicum Miller, Proc. U. S. Nat. Mus., Vol. 42, No. 1882, p. 25, March 6, 1912. Type from Cabima, Panama.

The Isthmian chiroderma is a rather small, brownish bat with the outer side of the forearm and the upper side of the interfemoral membrane well clothed with fur. A white dorsal stripe which is conspicuous in *Chiroderma salvini* seems to be indistinct or obsolete in this species. The forearm measures about 45 millimeters.

Chiroderma isthmicum was based on two specimens obtained by August Busck at Cabima. An individual flew into my room at Cana during the evening of May 21, 1912, and alighted on the wall where it was captured and one presented by Mr. George A. Brown was secured by him at Culebra.

Specimens examined: Cabima, 2 (including type); Cana, 1; Culebra, 1.

CHIRODERMA SALVINI Dobson

Salvin's Bat

Chiroderma salvini Dobson, Catal. Chiropt. Brit. Mus., p. 532, 1878, pl. 29, fig. 3. Type from Costa Rica.

Salvin's bat is a handsome species, dark brown above, the face marked with white stripes, a pair of which extend from the outer edges of the nose leaf upward diverging gradually to near the inner sides of the ears. Another pair of short stripes reach backward, one on each side, from the angles of the mouth. A distinct white median dorsal stripe is also present. The forearm measures about 53 millimeters. Contrasted with *C. isthmicum* this bat is recognizable by larger size, and apparently by the conspicuous white facial and dorsal markings. The latter character may be unreliable, however, as it is known to be variable in some species of bats belonging to this general group.

A single individual was knocked down as it flew through a lighted corridor at the Darien gold mines at Cana, May 7, 1912. No others appear to have been taken in Panama, but the species was recorded from Colombia by Alston (1879, p. 207).

Specimens examined: Cana, 1.

Genus ARTIBEUS Leach

The genus *Artibeus* includes species varying in size from rather large to small, some of which range far north in Middle America. A pair of white facial stripes arising from the sides of the nose

extend to near the inner base of the ears and a shorter lateral pair normally reach upward from near the corners of the mouth. In the possession of these markings and the absence of a dorsal stripe *Artibeus* agrees with *Vampyressa,* but the ears are more pointed and the disparity in size externally distinguishes the two genera. Moreover, the skulls differ rather widely in detail; the upper incisors are bifid in both genera, but while about as broad as high in *Artibeus* they are much higher than broad in *Vampyressa.* Some of the teeth are vestigial and may be absent in certain species, the number for the genus varying from 28 to 30 or 32.

ARTIBEUS WATSONI Thomas

Watson's Bat

Artibeus watsoni Thomas, Ann. Mag. Nat. Hist., Ser. 7, Vol. 7, p. 542, June, 1901. Type from Bugaba, Chiriqui, Panama.

Watson's bat may be distinguished from its Panama congeners by much smaller size and more distinct white facial stripes. The forearm measures about 40 millimeters. The edges of the ears are yellowish, much as in *Uroderma bilobatum* and *Vampyrops helleri.* The known range of the species is Panama and Nicaragua. Several similarly small and apparently not very distinctly related species inhabit northern South America.

At Gatun a single individual was found clinging to the under side of a banana leaf in an old field. The only other specimen obtained by me was knocked down near the entrance to the tunnel of an old mine at Cana.

Thomas (1903*a,* p. 40), the original describer of the species, recorded additional specimens from Sevilla and Cebaco, both small islands off the southern coast of western Panama. The same material was examined by Andersen (1908, p. 289) and listed in his monograph of the genus. Six specimens, collected by J. H. Batty at Boqueron, were recorded by Allen (1904, p. 79); six specimens from Chepigana are listed by Anthony (1916, p. 373).

Specimens examined: Boqueron, 6[1]; Cana, 1; Chepigana, 6[1]; Gatun, 1.

ARTIBEUS JAMAICENSIS JAMAICENSIS Leach

Jamaican Bat

Artibeus jamaicensis Leach, Trans. Linn. Soc., Vol. 13, 1821, p. 75. Type from Jamaica.

The Jamaican bat is doubtless common at the lower elevations throughout Panama. It is a large robust species with rather indis-

[1] Collection Amer. Mus. Nat. Hist.

tinct whitish facial stripes of which a supraorbital pair usually extend from the nose pad to near the inner sides of the ears, and a pair, faintly indicated (or absent), reach from near the angle of the mouth toward the ears. The forearm measures about 62 millimeters. Examination of the skull is necessary in order to distinguish this bat with certainty from *Artibeus planirostris planirostris.* It lacks the tiny third upper molar present at the posterior end of the series in the latter form.



FIG. 16.—Artibeus jamaicensis jamaicensis.
No. 203082, U. S. Nat. Mus. About nat. size.

Dr. Knud Andersen (1908) in a revision of the genus states (p. 266) that "to prevent wrong identification it is important to emphasize that *Central America is inhabited by two races,* which ought not to be (but hitherto have always been) confused, viz., the smaller (truly indigenous) *A. j. jamaicensis* and the larger *A. j. palmarum* (an immigrant from south)." In similar language he reiterates (p. 278) that "in Central America and S. Mexico *A. j. palmarum* meets the considerably smaller *A. j. jamaicensis.* There is no doubt whatever that the latter race is the truly indigenous form in the region north of Panama, and that *A. j. palmarum* is a late intruder from the south into the same region." Dr. Andersen's positive assertions, made after a careful study of the group, should be given considerable weight; but since the forms as recognized by him appear to be characterized by average differences only, his interesting conclusions in regard to their geographic ranges seem open to serious question. The Middle American material recorded by him includes four specimens from Bugaba, Chiriqui, referred to *A. p. palmarum,* and a single example from Colon referred to *A. j. jamaicensis.*

Most of the specimens from Panama examined by me are indistinguishable from typical *A. j. jamaicensis,* having about the same general dimensions (forearm rarely reaching 65 millimeters) and degree of posterointernal emargination of the second upper molar, and the same dark color, including indistinct facial stripes. Although Bugaba examples are somewhat larger, I assign them, along with the others, to the typical form.

A colony, comprising 50 or more of these bats, was located in a shallow recess in the side of the high rock forming the center of the islet known as San José Rock in the Bay of Panama. W. H. Osgood and I visited the place together and obtained specimens, a part of which are now in the Field Museum of Natural History. The bats were suspended in crevices.

At Gatun several were caught in traps placed about a bunch of ripening bananas that had been left uncut in an old field, and to which the bats came to feed at night. At the same locality a single individual was found clinging within a curled fragment of dead banana leaf which still adhered to the plant at a point about six feet from the ground. The colors of the bat blended well with those of the leaf. Several were dislodged by firing into cavities in the arch of the natural bridge over the Rio del Puente a few miles north of Alhajuela, but one only was secured as a specimen.

A specimen obtained by W. W. Brown, Jr., at Bugaba, Chiriqui, was listed by Bangs (1902, p. 50) as *Artibeus intermedius.* Under the same name, Bangs (1906, p. 213) recorded an individual taken by the same collector at Calidonia (near Panama). The specimen from Bugaba, measuring 77 millimeters in length of forearm, was subsequently referred by G. M. Allen (1908, p. 42) to *Artibeus palmarum,* and Knud Andersen (*l. c.*) in the same year recorded material from the same locality as subspecies *palmarum.* Miller (1912, p. 26) assigned to *A. j. jamaicensis* three specimens collected by August Busck on Taboga Island.

An interesting and rather detailed account of the habits of this bat, as observed by W. Osburn in Jamaica, was published many years ago.[1] Osburn found them inhabiting caves in great numbers. While they sometimes lived in places from which the light was wholly excluded, they particularly haunted the entrances of caves, or caves of shallow depth, which led him to remark that " it certainly does not seem such a lover of darkness as the generality of the family." He also found them " clustering under the fronds of the cocoanut palm, so thickly and in such numbers that at a single shot I brought down twenty-two, while many flew off and took refuge in neighboring trees."

Specimens examined: Bugaba, 1 [2]; Boquete, 1 [2]; Calidonia, 1; Culebra, 1; Gatun, 6; Rio del Puente (natural bridge near Alhajuela), 1; San José Rock (Bay of Panama), 11; Taboga Island, 34.[3]

[1] Proc. Zool. Soc. London, 1865, pp. 64-67.

[2] Collection Mus. Comp. Zool.

[3] Ten in collection Museum Comp. Zool.

ARTIBEUS PLANIROSTRIS PLANIROSTRIS (Spix)

Flat-nosed Bat

Phyllostoma planirostre Spix, Simiar. et Vespert. Brasil, 1823, p. 66, pl. 36, fig. 1. Type from Bahia, Brazil.

The flat-nosed bat very closely resembles *Artibeus j. jamaicensis*. The two species are sometimes difficult to distinguish apart by any external character, but *A. p. planirostris* differs, normally, in the possession of a third upper molar, a tiny tooth appearing at the posterior end of the series. But in some skulls even this differential character partially fails as these small teeth may be lost on one or both sides. In such cases, however, the alveolus of the missing tooth persists at least for a time.

A. planirostris appears to be a rare bat in Panama, while *A. j. jamaicensis* is one of the common species of the region. No specimens of the former were met with by me, but specimens from Bugaba and Boquete erroneously listed by Bangs (1902, p. 50) as *A. intermedius* were of this species as has been indicated by G. M. Allen (1908, p. 39). A bat collected by J. H. Batty at Boqueron, Chiriqui, and recorded by J. A. Allen (1904, p. 79) as *A. intermedius* proved on reexamination by him (1904, p. 233) to be an example of *A. planirostris* with the third molar on each side absent. Dr. Allen's later determination is evidently correct.

Specimens examined: Boqueron,[1] Boquete, 1,[2] Bugaba, 1.[2]

Family DESMODONTIDAE

The family Desmodontidæ includes the true vampire bats which subsist upon the blood of animals, probably to the exclusion of other food. Contrary to a popular conception they are not especially repugnant in appearance and are surpassed in size by many harmless species. The ears are short; the nose is bordered by cutaneous folds with a V-shaped notch in the middle above the nostrils. There is no external tail, and the interfemoral membrane is reduced to a narrow fringe. The general pelage is short and somewhat hispid, rusty brownish in color, rather coarse hairs extending the full length of the forearm and well down over the interfemoral membrane and hind limbs. The highly specialized dentition is distinctive, the median upper incisors consisting of greatly developed, trenchant, chisel-like teeth which exceed the canines in size and are largely instrumental in making the incision when blood is drawn. These bats often attack

[1] Collection Amer. Mus. Nat. Hist.

[2] Collection Mus. Comp. Zool.

horses and mules and rather rarely bite human beings, but since vast areas unoccupied by man are inhabited by them in considerable numbers, they doubtless prey normally upon native mammals or birds. Three genera are known, two of which, *Desmodus* and *Diphylla,* are represented in Panama.

Genus DESMODUS Wied

Blood-sucking bats met with throughout tropical Middle America usually belong to the genus *Desmodus,* the other Desmodont genus of the region, *Diphylla,* being exceedingly rare. *Desmodus* is distinguishable externally from *Diphylla* by the longer, more pointed ears, and the long thumb, equal to about one-fifth the length of the third finger, with two prominent pads on the inner side of the metacarpal. The calcar is short, stumpy, and supports no part of the interfemoral membrane. More important generic characters are lodged in the teeth, which differ notably in form and are reduced to 20 in number.

DESMODUS ROTUNDUS MURINUS Wagner

Mexican Vampire Bat

D[esmodus] murinus Wagner, Schreber's Säugthiere, Suppl., Vol. 1, p. 377 (1839), 1840. Type from Mexico.

Although few examples were met with by me the Mexican vampire bat is probably rather common at low elevations throughout Panama. Specimens of *Desmodus* from Mexico average smaller than those



Fig. 17.—Desmodus rotundus murinus.
No. 179723, U. S. Nat. Mus. About nat. size.

from Paraguay, assumed to represent typical *D. rotundus,* and seem referable to a northern race for which the name *D. murinus* Wagner may be used, as has been shown by Osgood.[1]

The difference in size between the northern and southern forms is, however, rather less than might be inferred from measurements by Osgood (*l. c.*). He gives the length of the forearm in typical *D. rotundus* as 60-64 millimeters, as against a maximum of 55 millimeters in Mexican and Guatemalan specimens referred to the north-

[1] Pub. Field Mus. Nat. Hist., Zool. Ser., Vol. 10, No. 5, p. 63, Jan. 10, 1912.

ern subspecies. I find Mexican specimens that fully equal his measurements for typical *D. rotundus,* and Paraguayan examples that exceed those measured by him. But, while individuals are practically indistinguishable the southern race averages considerably larger, the difference in size seemingly more noticeable in the skulls than in external dimensions. The rather scanty material available from Panama indicates that the region is inhabited by a form somewhat intermediate in size but nearest to *D. r. murinus.*

A few vampires were found clinging in a recess of the high-vaulted roof of a limestone cave in the forest near Cana. Four secured as specimens had their stomachs distended with blood which had thickened and become very dark in color. One of these that had been knocked down was only partially disabled, and on being rather incautiously handled suddenly snapped at my finger. The canine teeth were not brought to bear, but the upper incisors neatly scooped out and completely removed a bit of skin leaving a wound from which blood flowed freely. In other parts of the same cave were colonies of *Hemiderma perspicillatum aztecum, Hemiderma castaneum, Glossophaga soricina leachii, Lonchophylla robusta,* and *Lonchophylla concava.*

Three specimens of this species collected by W. W. Brown, Jr., at Bogava were included by Bangs (1902, p. 51) in his list of "Chiriqui Mammalia," and a single example taken by J. H. Batty at Boqueron was recorded by Allen (1904, p. 79). Detailed measurements of an adult female obtained by August Busck on Taboga Island have been published by Miller (1912, p. 26).

Of this vampire bat Dr. Linnaeus Fussell (see Hale, 1903, p. 244), who had medical charge of a U. S. Government surveying party in eastern Panama in 1870, says in his report: "The bites of vampire bats should be referred to, as the stories told of them are by many deemed rather apochryphal. We were troubled with them more or less during the whole time we were out, but ordinarily they did not prove a serious annoyance; toward the latter part of our trip, however, some one was bitten almost every night; one night, the 13th of May, nine men were bitten. The men were rarely awakened by the bites, which, however, bled freely, sufficient blood being usually lost to saturate the clothing, and to show its effects very perceptibly in the loss of color and general feeling of weakness experienced."

While the fact that vampire bats, presumably of this species, attack man is fairly well established, such attacks seem to be rare in Panama. No instance came under my observation, and many people habitually

sleep in the open air, unprotected by netting. I was told that in a few instances bats had been known to bite sleeping natives, usually choosing the ears or toes for their attacks. Horses and mules, however, frequently suffer from them. Streaks of blood-matted hair extending down from small incisions on the withers or sides of the neck are common evidence of their nocturnal visits. The wounds are usually slight and heal quickly without attention, but sometimes become infested with the larvæ of viviparous flies which may cause the death of the animal.

Specimens examined: Boqueron, 1[1]; Bogava, 3[2]; Cana, 4; Taboga Island, 2.

Genus DIPHYLLA Spix

The genus *Diphylla* is externally similar to *Desmodus,* but has shorter, more rounded ears; the thumb is reduced to about one-eighth instead of about one-fifth the length of the third finger, and its metacarpal lacks the distinct pads on the inner side in the latter genus. The corresponding teeth differ in important structural details from those of *Desmodus,* and are increased by a pair of minute outer incisors, and a pair of upper and lower molars, to 26 in number.

DIPHYLLA CENTRALIS Thomas

Central American Vampire Bat

Diphylla centralis THOMAS, Ann. Mag. Nat. Hist., Ser. 7, Vol. 11, p. 378, April, 1903. Type from Boquete, Chiriqui, Panama.

The Central American vampire bat, whose general characters are those of the genus, is definitely known only from the type which was collected at Boquete, on the southern slope of the Volcan de Chiriqui, by H. J. Watson.

It is described as "externally quite similar to *D. ecaudata,* except that the legs are rather less heavily haired, and there is not so much white on the digits and tips of the wings. Colour of back and belly, where the hairs are dark to their bases, near 'seal brown'; anteriorly on the shoulders and neck the colour is markedly lighter, owing to the broad whitish bases to the hairs, *D. ecaudata* is rather darker throughout, with less white on the bases of the shoulder hairs.

"Skull rather rounder and less sharply arched above than in *D. ecaudata;* interorbital region narrower. Zygomata more widely and evenly spread. Bullæ larger and higher."

It is represented as differing from *D. ecaudata,* however, mainly in dental characters, the last three lower cheek teeth being subequal

[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Mus. Comp. Zool.

in size, while in the latter species the fourth lower premolar is fully twice the size of the first lower molar, and half again as large as the third lower premolar. Thomas further remarks that "in spite of their general resemblance to each other the difference in the proportions of the lower teeth seems to necessitate the distinction of the Central-American *Diphylla* from that of Brazil." The forearm measurement given is 54 millimeters. Specimens of *Diphylla* from as far north as southern Mexico may prove to be referable to this species.

Family NATALIDAE

The members of the family are small, delicately formed bats, the continental representatives of which are recognizable by peculiar, low, somewhat funnel-shaped ears, long, slender limbs, large interfemoral membrane and the absence of nose leaves. The skull is long and narrow, with high subglobose braincase; the palate is excised anteriorly, but the premaxillæ meet in the median line in front of two well-developed foramina; postorbital processes are absent.

Genus NATALUS Gray

Salient characters of the only known continental genus of this restricted group have been given under the family. In addition, the long, thread-like tail crosses the interfemoral membrane, which is naked, except for a thin line of fringing hairs along the posterior margin. The teeth are 38 in number.

NATALUS MEXICANUS Miller

Mexican Straw-colored Bat

Natalus mexicanus MILLER, Proc. Acad. Sci. Philadelphia, p. 399, September 12, 1902. Type from Santa Anita, Lower California, Mexico.

Rich golden yellow appears to be the normal color of *Natalus mexicanus,* but individuals vary to dark brown. The color in con-



FIG. 18.—Natalus mexicanus.
No. 52117, U. S. Nat. Mus. About nat. size.

junction with the thin papery ears and flying membranes will aid in identification of the species. Its occurrence in Panama is known only from the record by Allen (1904, p. 78) of a single specimen

collected by J. H. Batty on Coiba Island. In reduced size, most obvious in the length of the skull and toothrows, this example agrees closely with the Mexican form which is probably a small, geographic race of *Natalus stramineus*.[1] The forearm measures 38.4 and the upper toothrow (front of canine to back of posterior molar) 6.4 millimeters.

Specimens examined: Coiba Island, 1.[2]

Family VESPERTILIONIDAE. Common Bats

Most of the common bats of northern latitudes are included in the family Vespertilionidæ which, with several subfamily divisions, ranges over the greater part of the land surface in both the eastern and western hemispheres. The Isthmian members of the family are distinguishable externally by the combination of medium or small size, slender general structure, simple noses, narrow, usually pointed ears, slender tragus, long tail reaching to near posterior border of wide interfemoral membrane, and absence of adhesive disks on the soles and thumbs. A notable feature of the skull is a broad and deep U-shaped median, anterior emargination of the palate and the resultant obliteration of palatal branches of the premaxillæ. Five genera are now known to represent the family in Panama.

Genus MYOTIS Kaup

The bats of the genus *Myotis* superficially resemble those of several related genera and examination of skulls is often desirable in order to make positive determinations. The two known Panama representatives are, however, usually recognizable by the combination of color and size; the colors are dark brown or blackish and the length of the forearm 34 to 36.5 millimeters. They thus exceed the measurements of *Rhogeëssa* and do not attain the dimensions of the other Vespertilionine genera of the region. The skull of *Myotis* is slender and of rather delicate structure, the braincase rounded and usually rising high behind the narrow, depressed rostrum. Three upper premolars are normally present on each side, and the teeth are normally 38 in number. In certain species a pair of small obsolescent upper premolars may be present or absent.

[1] In describing *Natalus mexicanus* Mr. Miller used for comparison specimens from Dominica as representing *N. stramineus*, whose exact type locality, however, remains undetermined.

[2] Collection Amer. Mus. Nat. Hist.

MYOTIS NIGRICANS (Wied)

Little Black Bat

V[espertilio] nigricans WIED, Beitrage zur Naturgesch, v. Brasilien, Vol. 2, p. 266, 1826. Type from Fazenda de Aga, near the Iritiba River, southeastern Brazil.

V[espertilio] exiguus H. Allen, Proc. Acad. Nat. Sci. Philadelphia, 1866, p. 281. Type from Aspinwall (now Colon), Panama.

Myotis chiriquensis Allen, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 77, February 29, 1904. Type from Boqueron, Chiriqui, Panama.



FIG. 19.—Myotis nigricans.
No. 179721, U. S. Nat. Mus. About nat. size.

The little black bat is a small, slender, blackish or brownish black species with a very small foot. In general appearance it is not very unlike *Eptesicus propinquus,* but is distinctly smaller. The forearm measures about 34 millimeters. Specimens from Panama seem indistinguishable in any way from a series from Sapucay, Paraguay, assumed to represent typical *M. nigricans.*

At Bohio a few of these bats were located in a vacant part of the old police station. They were clinging to the wall, several inches apart in an upper corner of a half-dark room. Others were found in an old tunnel formerly used for the storage of dynamite at the same locality. A specimen from Bugaba is recorded by Bangs (1902, p. 50), and two from Boqueron are listed by Allen (1904, p. 77). Anthony (1916, p. 373) notes the species from Chepigana, Cituro, Real de Santa Maria, Gatun, Tacarcuna, and Tapalisa as *Myotis chiriquensis.*

The type of *Vespertilio exiguus* H. Allen has been searched for in the U. S. National Museum, and Mr. James A. G. Rehn informs me that it cannot be found in the collection of the Academy of Natural Sciences of Philadelphia. It seems to have been lost. The description is of a small bat conforming closely in size and general characters with *Myotis nigricans* and it seems best to assign the name to the synonym of this species.

Examination of the type of *Myotis chiriquensis* shows that the forearm was broken off when the specimen was prepared and it is not, therefore, normally so short as Dr. Allen supposed. There seems to be no character by which it may be separated from *M. nigricans.*

Specimens examined: Boca de Cupe, 1; Bohio, 4; Boqueron, 3[1]; Bugaba, 1[2]; Cana, 1; Chepigana, 1[1]; Cituro, 1[1]; Culebra, 2[3]; Gatun, 1; Real de Santa Maria, 3[1]; San Pablo, 1; Tabernilla, 2; Taboga Island, 1; Tacarcuna, 2[1]; Tapalisa, 3.[1]

MYOTIS —— sp. indet.

An alcoholic specimen, with skull removed, in the Museum of Comparative Zoology, from San Pablo, Canal Zone, belongs to a widely ranging group which Mr. Gerrit S. Miller, Jr., informs me includes *Myotis yumanensis, Myotis albescens,* and other geographic races in both North and South America. The example differs from *M. yumanensis* in the dark color of its pelage, but the skull is not very obviously unlike those of several currently recognized species, and in the present unrevised condition of the genus the specimen cannot satisfactorily be determined. The forearm measures 36.4.

Genus EPTESICUS Rafinesque

The broad, naked membranes combined with larger size (forearm about 40 millimeters or more) suffice to distinguish members of the genus *Eptesicus* from other Panama representatives of the family. The skull is flatter with broader, heavier rostrum than that of *Myotis* and more nearly resembles that of *Rhogeëssa* in form. As in *Myotis,* and unlike *Rhogeëssa,* two pairs of upper incisors are present, but a departure from the *Myotis* formula results from the reduction of the upper premolars to the single pair present in *Rhogeëssa.* The teeth are 32 in number. Two species are known to occur within our limits.

EPTESICUS PROPINQUUS (Peters)

Peters' Black Bat

Vesperus propinquus Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, 1872, p. 262. Type from Santa Isabel, Guatemala.

This rather small, dark brown, slenderly formed species bears a general external resemblance to *Myotis nigricans,* but is considerably larger. The forearm measures about 41 millimeters.

The specific distinctness of this bat from *Eptesicus fuscus* (Beauvois), with which it had been subspecifically associated, has been pointed out by Osgood.[4] It is smaller and differs otherwise

[1] Collection Amer. Mus. Nat. Hist.

[2] Collection Mus. Comp. Zool.

[3] One in collection Amer. Mus. Nat. Hist.

[4] Proc. Biol. Soc. Wash., Vol. 27, p. 101, May 11, 1914.

from the forms of *E. fuscus,* and the northern part of its range is overlapped by that of *Eptesicus fuscus miradorensis* (H. Allen). The exact relationship of *E. propinquus* to *Eptesicus hilarii* (Is. Geoffroy) and other South American species is, however, not so clear.

A small colony of *E. propinquus* was located in a dark corner of the attic of an old house at San Pablo, a locality now covered by Gatun Lake. The walls of the room had been white-washed and when a window was opened the dark color of the bats rendered them conspicuous. A few individuals of *Rhogeëssa tumida* were clinging to rafters nearby.

Specimens examined: San Pablo, 3.

EPTESICUS FUSCUS MIRADORENSIS (H. Allen)

Mirador Brown Bat

S[cotophilus] miradorensis H. Allen, Proc. Acad. Nat. Sci. Philadelphia, 1866, p. 287. Type from Mirador, Vera Cruz, Mexico.

The Mirador brown bat is one of the larger forms of Vespertilionidæ occurring in the region under consideration. It is externally similar to *Eptesicus propinquus,* but is decidedly larger, the forearm measuring about 50 millimeters in length. It also differs in dark brown instead of blackish color.



Fig. 20.—Eptesicus fuscus miradorensis.
No. 53784, U. S. Nat. Mus. About nat. size.

Eptesicus f. miradorensis was first made known from Panama by Bangs (1902, p. 50), who noted a single specimen collected by W. W. Brown, Jr., at Boquete, Chiriqui. Allen (1904, p. 78) lists examples taken at the same locality by J. H. Batty. This locality on the southern slope of the Volcan de Chiriqui, in the western part of the republic, marks the southern limit of the known range of *Eptesicus fuscus.* This species in its several forms is one of the most common in the area to the northward, including the entire United States and adjoining British territory. The skulls of examples from Boquete

are slightly larger than in Mexican specimens with which they have been compared, but the external dimensions are about the same.

Specimens examined: Boquete, 4.[1]

Genus NYCTERIS Borkhausen

The genus *Nycteris* is easily recognizable by the continuation of the dense body fur over the hind limbs and the entire upper side of the wide interfemoral membrane. Distinctive tufts of fur appear also at the upper base of the thumb and along the basal portion of the fourth finger. In the allied genus *Dasypterus* the interfemoral membrane is much less extensively clothed. The skull of *Nycteris* is short and the rostrum broad and massive, very much as in *Dasypterus*, but a pair of minute upper premolars is not present in the latter genus. The teeth are 32 in number.

NYCTERIS BOREALIS MEXICANA (Saussure)

Mexican Red Bat

A[*talapha*] *mexicana* Saussure, Rev. et Mag. de Zool., Ser. 2, Vol. 13, p. 97, March, 1861. Type from southern Mexico.

The rich reddish brown color of the upperparts, including the fur covering the hind limbs and the entire upper side of the wide inter-



Fig. 21.—Nycteris borealis mexicana. No. 122663, U. S. Nat. Mus. About nat. size.

femoral membrane distinguishes this bat from the otherwise similar form, *Dasypterus ega panamensis*, and all others of the general region. The ears are short and rounded as in *Dasypterus*. The forearm measures about 41 millimeters.

Bangs (1902, p. 50) records a specimen collected by W. W. Brown, Jr., at 4,800 feet near Boquete on the southern slope of the Volcan de Chiriqui, where the species reaches the extreme southern known limit of its distribution.

Specimens examined: Boquete, 1.[2]

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[1] Three in collection Amer. Mus. Nat. Hist.; one in Mus. Comp. Zool.

[2] Collection Mus. Comp. Zool.

Genus DASYPTERUS Peters

The genus *Dasypterus* is similar externally to *Nycteris,* but the hind limbs and the posterior part of the interfemoral membrane are naked. The skull indicates alliance to *Nycteris,* but the absence of the small anterior upper premolars still appearing in that genus is distinctive. The teeth are 30 in number.

DASYPTERUS EGA PANAMENSIS Thomas

Panama Short-eared Bat

Dasypterus ega panamensis THOMAS, Ann. Mag. Nat. Hist., Ser. 7, Vol. 8, p. 246, September, 1901. Type from Bugaba, Chiriqui, Panama (altitude 800 feet).

The type in the British Museum is the only known specimen of this bat. It was collected at Bugaba in western Panama by H. J Watson, October 8, 1898. It is described as dark brownish clay color in general tone above, instead of buffy white as in typical *Dasypterus ega* of Brazil. The forearm measurement given is 46.5 millimeters.

Bats of the genus *Dasypterus* appear to be rare in Middle America. They may be recognized by the rather unusual color among bats, together with the short rounded ears, and the long tail which supports the gradually narrowing interfemoral membrane to a point well beyond the feet. Another Middle American form, *D. ega xanthinus* Thomas has been described from Lower California.

Genus RHOGEËSSA H. Allen

The genus *Rhogeëssa* is similar externally to *Myotis,* but the yellowish brown color and small size sufficiently distinguish the Isthmian representative. The skull more nearly resembles that of *Eptesicus* in form, but the single pair of upper incisors and other details are distinctive. The teeth are 30 in number.

RHOGEËSSA TUMIDA H. Allen

Little Yellow Bat

Rhogeëssa tumida H. ALLEN, Proc. Acad. Nat. Sci. Philadelphia, 1866, p. 286. Type from Mirador, Vera Cruz, Mexico.

The small size, slender form, tiny foot, and naked interfemoral membrane together with rich yellowish brown color characterize this species, one of the smallest bats occurring in Panama. The forearm measures about 31.5 millimeters.

A few of these bats were found clinging from the rafters in the half dark attic of an old house at San Pablo, April 21, 1911. A corner of the same attic was inhabited by *Eptesicus propinquus*. Henry Pittier took a specimen of *Rhogeëssa tumida* at La Palma de Darien in January, 1912. Bangs (1902, p. 50) records a specimen



FIG. 22.—Rhogeëssa tumida.
No. 52065, U. S. Nat. Mus. About nat. size.

collected by W. W. Brown, Jr., at Bugaba, which was rather doubtfully referred to this species by G. S. Miller, Jr.

Specimens examined: Bugaba, 1[1]; La Palma de Darien, 1; San Pablo, 3.

Family MOLOSSIDAE

The family Molossidæ includes large, medium and small bats with short, thick, leathery ears, broader than high, and projecting far forward over the eyes. The short thick muzzle is not provided with a nose leaf, the legs are short and the long tail projects prominently beyond the posterior border of the short interfemoral membrane. The general pelage is short and velvety; very short hairs with thickened and more or less distinctly spoon-shaped tips are present on the upper lip, and similarly modified hairs form a fringe along the under and outer sides of the lateral digits of the foot; more conspicuous but slender hairs with recurved tips project beyond the claws. The wings are very narrow, and together with the peculiar shape of the ears give bats of this group an angular appearance in flight.

Genus MOLOSSOPS Peters

The genus *Molossops* closely resembles *Molossus* in external appearance, but more conspicuous lines of fur diverging from the angle in the bend of the wing along the forearms and fourth finger are usually distinctive. The skull is distinguishable from those of *Molossus* and *Eumops* by the high, but broad, flattened rostrum with conspicuous, laterally projecting lachrymal ridges. Distinct basispenoid depressions are absent. In the species reaching Panama the teeth are 28 in number, but vary in the genus to 26.

[1] Collection Mus. Comp. Zool.

MOLOSSOPS PLANIROSTRIS (Peters)

Flat-nosed Mastiff Bat

M[olossus] planirostris PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, 1865, p. 575. Type from British Guiana.

Molossops planirostris appears to be mainly South American in distribution, but G. M. Allen (1908, p. 56) directs attention to a specimen collected near the City of Panama by W. W. Brown, Jr., and erroneously referred to *Promops nanus* by Bangs (1906, p. 212). As Dr. Allen states, " the presence of this species within the limits of Middle America " is thus established.

Specimens examined: Panama (near city), 1.[1]

Genus EUMOPS Miller

Among the known Panama Molossine bats the genus *Eumops* is readily recognizable externally by the connection of the ears across the forehead. The skull is similar in general outline to that of *Molossus,* but the rostrum is narrower and dental differences are various. The upper incisors project forward far beyond the plane of the canines and an additional pair of outer incisors is present. The basisphenoid depressions are distinct as in *Molossus.* The teeth are variable in number, 30 being present in the two Panama species.

EUMOPS NANUS (Miller)

Dwarf Mastiff Bat

Promops nanus MILLER, Ann. Mag. Nat. Hist., Ser. 7, Vol. 6, p. 470, November, 1900. Type from Bugaba, Chiriqui, Panama.

The dwarf mastiff bat, originally described from western Panama, was not met with by me in the eastern part of the republic. A specimen collected near the city of Panama by W. W. Brown, Jr., and recorded as *Promops nanus* by Bangs (1906, p. 212) is referable to *Molossops planirostris* as pointed out by G. M. Allen (1908, p. 56). As Miller aptly remarked, the species is essentially a miniature of *Eumops glaucinus.* The forearm measures about 39 millimeters, instead of 59 millimeters as in the latter animal.

Specimens examined: Bugaba, 1.

EUMOPS GLAUCINUS (Wagner)

Chestnut Mastiff Bat

Dysopes glaucinus WAGNER, Wiegmann's Archiv. f. Naturg., 1843, p. 368. Type from Cuyaba, Matto Grosso, Brazil.

This rather large bat, mainly South American in distribution, was not until recently known to occur in Middle America. It is one of

[1] Collection in Mus. Comp. Zool.

the largest of the *Molossidae* of the region, and in general external appearance is not very unlike the typical genus *Molossus,* the short thick leathery ears projecting forward and overhanging the eyes in the same way. The forearm measures about 59 millimeters.

A large colony was found inhabiting the roof of the old police station at Bohio. The bats remained during the day between the corrugated iron roof and the ceiling. Looking through crevices a considerable number could be seen ranged in rows with their heads upward, their backs close to the iron, and their bodies lying flat on the boards. They held on to some extent with their thumbs. The sun was shining and the bats were panting with the almost intolerable heat radiating from the iron. When disturbed they crawled about with lively shuffling motions, seeking always to keep out of sight in the crevices. They were finally dislodged by tearing off the



FIG. 23.—Eumops glaucinus.
No. 179856, U. S. Nat. Mus. About nat. size.

roof. Some of them, liberated in a room from which they could not escape, flew round and round and finally hung up by their feet in corners, swinging heads downward in the usual position of bats when at rest. The building was soon torn down and the locality is now submerged in Gatun Lake.

A specimen collected by August Busck, at Paraiso, was recorded by Miller (1912, p. 26).

Specimens examined: Bohio, 14; Empire, 1; Paraiso, 1.

Genus MOLOSSUS Geoffroy

Externally the genus *Molossus* is similar to *Molossops,* but the Panama forms are distinguishable by their smaller size in comparison with the only known regional representative of the latter. The absence of the conspicuously furred areas present on the upper side of the wing between the forearm and fourth finger in *Molossops* are distinctive. The skull differs notably from those of *Molossops* and *Eumops* in the anteriorly arched braincase and high, trenchant sagittal crest sloping down posteriorly to the low lambdoid ridge. The basispenoid depressions are distinct as in *Eumops.* The upper

incisors are less conical than in the genera mentioned and scarcely project beyond the plane of the canines. One pair only of upper premolars and one of lower incisors are present. The teeth are 26 in number.

MOLOSSUS COIBENSIS Allen

Coiba Island Mastiff Bat

Molossus coibensis ALLEN, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 227, June 29, 1904. Type from Coiba Island, Panama.

The Coiba Island mastiff bat is a small, short-haired, glossy species of a dark chestnut brown or rusty blackish general color. The short broad leathery ears hang far forward, and over-shadow the eyes. The long tail projects well beyond the interfemoral membrane. The forearm measures about 36.5 millimeters.



FIG. 24.—Molossus coibensis.
No. 202042, U. S. Nat. Mus. About nat. size.

This dark form was based by Dr. Allen on four specimens from Coiba Island, originally referred by him (1904, p. 78) to *Molossus obscurus*. It is nearly related to other forms of the *Molossus pygmaeus* group, at least some of which will no doubt eventually require reduction to subspecific rank.

In 1911 numbers of these bats inhabited the crevices between the corrugated iron roofs and the ceilings of old French buildings at Tabernilla and San Pablo. When a section of the iron roof of a building at San Pablo was lifted, the bats, finding themselves suddenly exposed to the full light of day, crawled rapidly over boards and plaster toward the cover of neighboring crevices. At Bohio a single individual was found clinging to the wall of a well-lighted room in the old police station. The windows were covered with mosquito netting and the bat had probably entered the room through a small hole in the ceiling, at night, and failed to find its way out again. Tabernilla, San Pablo, and Bohio are all localities now submerged in Gatun Lake.

A specimen probably assignable to *M. coibensis* was recorded by Thomas (1903*a*, p. 39) from Gobernador Island, under the name *Molossus obscurus*. Two examples of *M. coibensis* from San Pablo were referred to *M. crassicaudatus* by G. M. Allen (1908, p. 60).

Miller (1913, p. 92) in his review of the genus lists Panama specimens from Ancon, Chorrera, Culebra, Paraiso, and Tabernilla.

Specimens examined: Ancon, 1; Balboa, 4[1]; Bohio, 1; Chorrera, 3[2]; Coiba Island, 4[2] (including type); Culebra, 2; Panama City, 73[3]; Paraiso, 1; San Pablo, 18[4]; Tabernilla, 9; Boqueron, 2.[2]

MOLOSSUS SINALOAE Allen

Sinaloa Mastiff Bat

Molossus sinaloae Allen, Bull. Amer. Mus. Nat. Hist., Vol. 22, p. 236, July 25, 1906. Type from Escuinapa, Sinaloa, Mexico.

The Sinaloa mastiff bat is the largest species of the genus known to occur in Panama. It is similar to *Molossus bondae,* but larger and somewhat lighter in color, the upperparts being a dark brownish drab. The forearm measures about 47 millimeters.

The range of the species, as now understood, is from Sinaloa, Mexico, southward through Middle America to western Panama. Miller (1913, p. 89), in his revision of the genus, records specimens collected by R. E. B. McKenney at Punta de Peña.

Specimens examined: Punta de Peña (near Bocas del Toro), 2.

MOLOSSUS BONDAE Allen

Bonda Mastiff Bat

Molossus bondæ Allen, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 228, June 29, 1904. Type from Bonda, Santa Marta, Colombia.

The Bonda mastiff bat is very similar to *Molossus sinaloæ,* but is smaller and seems to be darker colored. The forearm measures about 40 millimeters.

The recorded range of the species is from northern Colombia into Panama. Miller (1913, p. 89), in his revision of the genus, lists specimens from Chorrera, one of which I have seen.

Specimens examined: Chorrera, 1.[2]

Order PRIMATES. Primates

Suborder Anthropoidea. Monkeys, Apes, Man

Family SAIMIRIDAE. Titi Monkeys

This family is represented in the region by the single genus *Saimiri,* which includes species scarcely exceeding some squirrels in

[1] Collection Field Mus. Nat. Hist.
[2] Collection Amer. Mus. Nat. Hist.
[3] Seventy-two in collection Mus. Comp. Zool.
[4] Six in collection Mus. Comp. Zool

size. They are easily distinguished from the Callitrichidæ, another group of small, squirrel-like species, by the short, instead of much elongated pelage, especially of the nape and sides, and the absence of a narrow and conspicuous median frontal crest.

Genus SAIMIRI Voigt. Titi Monkeys

The members of the genus *Saimiri* are similar in size to those of the genus *Leontocebus,* family Callitrichidae, which also inhabits the general region; but they differ widely in more essential respects. The general pelage is rather short, harsh and of nearly uniform length, instead of being long and soft, with an elongated mane or mantle covering the nape and overhanging the sides as in *Leontocebus;* and the short hairs of the face pass rather gradually into the pelage covering the top of the head, there being no narrow, conspicuous median crest as in the latter genus. The long tail is hairy to the tip.

SAIMIRI ÖRSTEDII ÖRSTEDII (Reinhardt)

Örsted's Titi Monkey

Chrysothrix örstedii Reinhardt, Vidensk. Middel. Nat. For. Kjöbenhavn, 1872, p. 157. Type from Chiriqui, Panama.

Örsted's titi monkey is externally recognizable by its squirrel-like size together with the white face, sides of neck, throat and chest which contrast strongly with the black crown. The back, hands and feet are rusty reddish.

The species was named for the Danish traveller Andreas Sandøe Örsted, who secured a specimen in Chiriqui many years ago. A skeleton of an animal probably of this species was provisionally referred by Sclater (1856, p. 139) to *Saimiris sciurea* (Linnaeus). It was collected by Thomas Bridges in the forest near David. Sclater later (1872, p. 3) assigned the same material to *Saimiris entomophaga* (D'Orbigny) with the remarks: "In 1856 I recorded the existence of a species of Squirrel Monkey in Central America, Mr. Bridges having procured, near David in Veragua, a skeleton of a species of this genus. . . . . I have no doubt that the Central American form is the black-headed *S. entomophaga,* as there is a skin of this species in the British Museum from Veragua (Arcé)." Alston (1879, p. 16) also mentions the Bridges specimen and examples sent from Chiriqui by Enrique Arcé.

Recent collectors have met with the animal at various localities in western Panama. Bangs (1902, p. 51) lists five specimens collected

by W. W. Brown, Jr., at Bugaba and says: "The squirrel monkey is common in the scrubby forest of the foothills of the Volcan de Chiriqui. It was very tame, and Mr. Brown states that often little parties of them, would follow him about in the underbrush, chattering, and allowing him to come so near that he could almost put his hand on them. It is a beautiful creature, with a long tasselled tail, and is admirably shown in Alston's plate in the Biologia Centrali-Americana. Mr. Brown states that he never saw a creature that he disliked so to kill, and after he had secured five specimens, nothing would induce him to molest the little troupes that accompanied him on his rambles over the foot-hills." Specimens taken by J. H. Batty for the Hon. Walter Rothschild are recorded by Thomas (1903*a*, p. 39) from Sevilla and Almijas, small islands near the southwestern coast of the republic. Examples obtained by the same collector at Boqueron were sent to the American Museum of Natural History, and included by Allen (1904, p. 80) in his annotated list of species. The animal is, so far as known, limited to western Panama. Another form, described by Thomas (1904, p. 250) as "*Saimiri oerstedi citrinellus*" with "head less blackened, and the limbs less yellow" inhabits adjacent parts of Costa Rica.

Specimens examined: Boqueron, 59[1]; Bugaba, 5.[2]

Family AOTIDAE. Night Monkeys

Among the monkeys of the region this aberrant family is characterized by nocturnal habits. The pelage is woolly, and in general appearance the members of the group are very unlike the other American monkeys; they bear a striking resemblance to some of the lemurs of the Old World.

Genus AOTUS Humboldt

The monkeys of the genus *Aotus* have very large and prominent eyes, which are doubtless correlated with their nocturnal habits. The face is marked by white frontal stripes, separated by a black median stripe. The tail is non-prehensile, and terminates in a small brush. One species is known from Panama.

[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Mus. Comp. Zool.

AOTUS ZONALIS Goldman

Canal Zone Night Monkey

[Plate 38, figs. 1 1*a*]

Aotus zonalis GOLDMAN, Smiths. Misc. Coll., Vol. 63, No. 5, p. 6, March 14, 1914. Type from Gatun, Canal Zone, Panama (altitude 100 feet).

The night monkey of the Canal Zone and eastern Panama may be easily recognized among the monkeys of the region by the characters given for the genus. It is similar to *Aotus griseimembra* of the Santa Marta region of Colombia in external appearance, the principal difference being a more buffy suffusion of the body and limbs. The skull differs in numerous details, especially the broader braincase, and the more depressed interorbital region which materially alters the facial angle; the larger molariform teeth of the Panama animal would alone serve as a distinguishing character. A species differing in the reddish color of the feet, *Aotus rufipes* (Sclater), has been described from Nicaragua.

Owing to nocturnal habits the night monkeys are seldom seen, and are therefore little known. Near Cana an example was obtained by me while using a hunting lamp in the forest at night. Its large eyes glowed conspicuously in the field of light projected into a tree top. Rustling branches and low squeaking sounds indicated that others were hurrying away in alarm. I did not hear the voice of the animal, which was described to me by native hunters as *who-who* given in a low monotonous tone. While in the forest near Boca de Cupe one afternoon I heard a slight rustling sound, and looking up beheld several curious little faces peering out of a dark hole about 15 feet from the ground in the trunk of a tree. After backing away a few steps I fired a shot into the hole and on examining the tree found that three of these monkeys had dropped to the ground inside the trunk, whence they were extracted by enlarging another hole. A native hunter described finding an adult and several young under similar circumstances. Anthony (1916, p. 374) records examples from Boca de Cupe and Tapalisa of which he says: "Although my specimens were taken in southeastern Panama, no material differences between them and the type from Gatun are evident. The type is less richly suffused, but this difference is probably not outside the limits of individual variation."

Specimens examined: Boca de Cupe, 4[1]; Cana, 3; Gatun (type locality), 4; Tapalisa, 7.[2]

[1] One in Amer. Mus. Nat. Hist.

[2] Collection Amer. Mus. Nat. Hist.

Family CALLITRICHIDAE. Squirrel Monkeys

The family Callitrichidae includes small squirrel-like monkeys of which the single genus *Leontocebus* inhabits Panama.

Genus LEONTOCEBUS Wagner. Squirrel Monkeys

The smallest monkeys of the region are included in the genus *Leontocebus.* They are little larger than squirrels which they resemble in form, posture and activity. The general pelage is long and soft, that of the nape and sides especially elongated as a mane, or mantle. The face is thinly clothed with short grayish hairs through which the dark-colored skin is visible to a sharp line of demarcation along the narrow and conspicuous median frontal crest. The hands and feet, with the exception of the great toe, are armed with long, sharp, strongly curved and laterally compressed claws which doubtless facilitate rapid movement. The tail is long, slender and non-prehensile.

LEONTOCEBUS GEOFFROYI (Pucheran)

Geoffroy's Squirrel Monkey; Mono tití

Hapale geoffroyi Pucheran, Rev. Zool., Vol. 8, p. 336, September, 1845. Type from Panama.[1]

Small size, together with the chestnut color of the nape, white fore limbs and frontal crest distinguish the *mono tití,* as this little monkey is known to natives of the Canal Zone. In western Panama the species is largely or entirely replaced by the similarly small, but otherwise very different animal, *Saimiri örstedii,* which bears the same local designation.

In the Canal Zone and at localities visited in eastern Panama, Geoffroy's squirrel monkey seems to be the most abundant representative of the order, ranging from sea level to at least 2,000 feet altitude on the slopes of the mountains. They were usually met with in troops of four or five, which quickly became alarmed at sight of me and scattered like squirrels, scurrying along the branches and often leaping several feet in passing from tree to tree, giving meanwhile rather weak squeaking cries.

The species has been well known in the Canal Zone for many years. In his list of "Quadrumana found in America north of Panama," Sclater (1872, p. 8) says: "I have recently recorded the receipt by

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[1] Locality given by Pucheran in account of *Hapale illigeri* on same page as that of *Hapale geoffroyi.*

the Society [Zoological Society of London] of a living example from Colon; and since that date other specimens have been received from the same port." Alston (1879, p. 17) records specimens from Panama, Colon, and Chepo, and mentions examples from Chiriqui formerly living in the gardens of the Zoological Society of London and believed by Sclater to be of this species. The animal is not represented in recent collections from western Panama and the latter record may be erroneous.

Anthony (1916, p. 374) in recording specimens from Boca de Cupe, Chepigana, Cituro, Maxon Ranch (Rio Trinidad), Tacarcuna and Tapalisa, says: "This small monkey was fairly common throughout the whole region where collecting was done, and specimens from the high mountains of the cordillera [vicinity of Mount Tacarcuna] are specifically the same as those of the Zone. In this series the yellowish underparts, which Elliot[1] made a character of his *salaquiensis,* a species which he withdrew[2] later upon the basis of additional material, occur frequently and show that this character is a variable one with no diagnostic value."

Specimens examined: Boca de Cupe, 1[3]; Cana, 2; Chepigana, 6[3]; Chepo, 1; Cituro, 4[3]; Maxon Ranch (Rio Trinidad), 1[3]; Tacarcuna, 12[3]; Rio Indio (near Gatun), 8; Tapalisa, 4.[3]

Family ALOUATTIDAE. Howling Monkeys

The howling monkeys, which alone compose this family, are remarkable mainly for their voices and the structural peculiarities that enable them to produce sounds that often reverberate for miles through the forest. The vertical expansion of the angle of the mandible, to a degree unusual among monkeys, is doubtless associated with the extraordinary inflation of the laryngeal apparatus which it partially protects.

Genus ALOUATTA Lacépède. Howling Monkeys

The members of the genus Alouatta are robust species, with rather long prehensile tails. They are similar in general appearance to those of the genus *Ateles,* but have shorter limbs and are distinguished by five instead of four fingers on the hands. One species only is known to inhabit the region.

[1] Elliot, Bull. Amer. Mus. Nat. Hist., 1912, p. 137.
[2] Elliot, Bull. Amer. Mus. Nat. Hist., 1914, p. 644.
[3] Collection Amer. Mus. Nat. Hist.

ALOUATTA PALLIATA INCONSONANS Goldman

Panama Howling Monkey; Mono Negro

[Plate 39, figs. 1, 1*a*]

Alouatta palliata inconsonans GOLDMAN, Smiths. Misc. Coll., Vol. 60, No. 22, pp. 17-20, February 28, 1913. Type from Cerro Azul, near the headwaters of the Chagres River, Panama (altitude 2,500 feet).

The Panama howling monkey is recognizable as a large black species with five fingers on the hands. It is closely allied to typical *A. p. palliata* of Nicaragua and Costa Rica, but the general color is clearer black, especially on the flanks, rump and posterior part of back. The skull differs in numerous details, the braincase being broader posteriorly, the frontal profile in the male rising more abruptly from the rostrum, the supraorbital protuberance being stouter, more projecting, the interpterygoid fossa broader, the audital bullæ flatter and the premolars narrower. It differs from the insular form, *A. p. coibensis,* in decidedly larger size.

Howling monkeys are generally distributed throughout the republic and range from near the coasts well up toward the summits of the higher mountains. The quaint account of monkeys in eastern Panama by Lionel Wafer (1729, p. 330) based on observations made in 1681, refers to several species apparently including the howler. It is quoted as follows:

" There are great Droves of Monkeys, ... most of them black; some have Beards, others are beardless. They are of a middle size, yet extraordinary fat at the dry Season, when the Fruits are ripe; and they are very good Meat, for we ate of them very plentifully. The *Indians* were shy of eating them for a while; but they soon were persuaded to it, by seeing us feed on them so heartily. In the rainy Season they have Worms in their Bowels. I have taken a handful of them out of one Monkey we cut open; and some of them 7 or 8 Foot long. They are a very waggish Kind of Monkey, and played a thousand antick Tricks as we marched at any Time through the Woods, skipping from Bough to Bough, with the young one's hanging at the old one's Back, making Faces at us, [and] chattering. . . . . To pass from Top to Top of high Trees, whose Branches are a little too far asunder for their Leaping, they will sometimes hang down by one another's Tails in a Chain; and swinging in that Manner, the lowermost catches hold of a Bough of the other Trees, and draws up the rest of them."

The habit of passing from tree to tree hanging by their tails in a chain is, of course, fictitious.

Howling monkeys occur in small numbers near Gatun in the northern end of the Canal Zone. Several parties were met with on the mountains near the headwaters of the Chagres River. On Cerro Azul a troop of about 12 was found in a group of very tall trees. The troop included several full grown males, females, and young. A very young individual was seen clinging to the lower part of its mother's back as she climbed into the topmost branches along with other females and the younger animals. The older males gave the usual roar when shots were fired, jumping about, looking down, and showing signs of anger rather than fear, as they made no effort to escape. After several of these monkeys were shot the others remained in the vicinity where they were seen on several subsequent occasions, being evidently permanent residents of that part of the forest. The so-called howling of these monkeys was heard soon after daylight nearly every morning not far from camp on the Cascajal River near Cerro Brujo, and at intervals during the day. Near the summit of the Pirre Range sudden showers of rain often brought forth deep-toned notes during the night. The voice of this animal as it reverberates through the forest, is wonderfully impressive, but seems better described as a series of deep growls, becoming a prolonged roar when given by several in unison, than as howling. Although the howler can pass rapidly through the tree tops, its movements seem sluggish when compared with those of *Ateles* or even *Cebus*. The flesh is eaten by the natives, but is less prized than that of *Ateles* and *Cebus*. It is commonly cut in strips and after being smoked over a fire may be kept for several days without salting. All of the specimens obtained carried numerous large larvae of flies, mainly in the skin on the throat, which added materially to their repugnant appearance. These larvae were not found on the spider monkeys taken in the same vicinity. Perhaps the greater activity of the latter may prevent the deposition of eggs.

Under the name *Alouatta palliata,* Bangs (1902, p. 51) lists three specimens collected by W. W. Brown, Jr., at 4,000 feet near Boquete. Specimens collected by J. H. Batty are recorded by Thomas (1903*a*, p. 39) from Sevilla, Almijas, and Insoleta, small islands near the southwestern coast of Panama. Regarding them he says: "Like mainland specimens these howlers are larger than the small insular form of Coiba Island, *A. p. coibensis* Thos." The same collector obtained a large series of specimens at Boqueron and Boquete for the American Museum of Natural History; measurements of selected individuals were published by Dr. Allen (1904, p. 79), who in the

same connection points out the great range of individual variation in color. The howlers of the mainland of western Panama seem referable to *A. p. inconsonans,* but in cranial details indicate gradation toward typical *A. p. palliata.* Anthony (1916, p. 374) says: "This monkey was noted the oftenest because of its far-reaching call-note. It seemed to be everywhere common from the Zone up to the crests of the cordillera." He lists specimens from Cituro, Maxon Ranch (Rio Trinidad), Tacarcuna, and Tapalisa.

Specimens examined: Boqueron, 2[1]; Boquete, 5[2]; Cerro Azul, 9; Cituro, 1[1]; "Gulf of Panama," 1[3]; "Isthmus of Panama," 1[3]; Maxon Ranch (Rio Trinidad), 1[1]; Mount Tacarcuna, 1[1]; Tapalisa, 1.[1]

ALOUATTA COIBENSIS Thomas

Coiba Island Howling Monkey

Alouatta palliata coibensis Thomas, Novitat. Zoologicæ, Vol. 9, p. 135, April 10, 1902. Type from Coiba Island, Panama.

The Coiba Island howling monkey was originally described as "a small insular race of the continental *A. palliata* Gray. The Howler Monkey of Coiba appears to have been reduced in size by its insular habitat in a way that the *Cebus* has not, for the latter is fully as large as its brethren on the mainland." The following remarks by Alston (1879, p. 4) doubtless apply to this form: "Mr. Salvin tells me that Captain Dow informed him that he once met with Howling Monkeys on the little island of Hicaron, which lies at the southern extremity of Quibo [Coiba] Island, off the coast of Veragua. The species would probably be *M. palliatus;* but it is difficult to understand how the founders of the colony could have reached this isolated spot from the mainland." Three specimens from Coiba Island collected by J. H. Batty indicate such disparity in size compared with the allied howler inhabiting the adjacent mainland that it seems best to regard it as a distinct species.

Specimens examined: Coiba Island, 3.[1]

Family CEBIDAE. Capuchin Monkeys

The restricted family includes the capuchin monkeys of the genus *Cebus,* some of whose distinguishing characters are given below.

Genus CEBUS Erxleben. Capuchin Monkeys

The monkeys of the genus *Cebus* are medium-sized species, readily distinguished in Panama by the white face, chest, and shoulders

[1] Collection Amer. Mus. Nat. Hist.

[2] Three in collection Mus. Comp. Zool.; two in Amer. Mus. Nat. Hist.

[3] Collection Mus. Comp. Zool.

The tail is long and curled under, but not naked near the tip. One species, represented by two subspecies, inhabits Panama.

CEBUS CAPUCINUS CAPUCINUS (Linnaeus)

Colombian White-throated Capuchin

S[imia] capucina LINNÆUS, Syst. Nat., ed. 10, Vol. 1, p. 29, 1758. Type region northern Colombia.[1]

The capuchins are recognizable by the extensive white area covering the entire face, sides of neck, throat, chest, and shoulders, in marked contrast with the glossy black remaining parts of the body. *C. capucinus* of recent authors is the animal which formerly was commonly referred to *C. hypoleucus* (Humboldt). The type locality of the latter is Rio Sinu, Colombia, and as the two are now regarded as identical the animal inhabiting eastern Panama and ranging as far southward as Paramba, Ecuador, is probably typical. In the vicinity of the Canal Zone *C. capucinus capucinus* is replaced by a northern geographic race, *C. c. imitator,* which is distinguished by the greater transverse extent of the premolars.

The white-throated capuchin was met with on several occasions, in the forests of eastern Panama, at localities ranging from 1,000 to 5,000 feet altitude. On Cerro Azul, near the headwaters of the Chagres River, a troop of eight or ten of these monkeys was found in the tops of tall trees on a steep hillside. When two were shot the others gave short cries of alarm and scampered off through the tree tops, showing great activity, but their progress seemed slower than that of *Ateles geoffroyi* under similar circumstances and I saw none of the tremendous flying leaps by which the latter species spans the distance between trees standing well apart. In the excessively humid forest covering the Atlantic slope of Cerro Brujo a small troop in the tops of tall trees remained quietly watching my party passing beneath. On Mount Pirre a lone male was heard giving hoarse barking sounds as he climbed rather slowly through the top of a tall tree in the heavy forest at 5,000 feet. The white area was conspicuous as he paused for a moment and looked down. Lionel Wafer (1729, p. 330) doubtless referred in part to this species when in describing the animals of eastern Panama he says: "There are great Droves of Monkeys, some of them white." Anthony (1916, p. 375) records specimens from Chepigana, Real de Santa Maria, and Tacarcuna (altitude 3,000 to 5,000 feet).

Specimens examined: Cerro Azul, 2; Cerro Brujo, 2; Chepigana, 1[2]; Mount Pirre, 3; Real de Santa Maria, 2[2]; Tacarcuna, 6.[2]

[1] See Goldman, Proc. Biol. Soc., Washington, Vol. 27, p. 99, May 11, 1914.

[2] Collection Amer. Mus. Nat. Hist.

CEBUS CAPUCINUS IMITATOR Thomas

Panama White-throated Capuchin

Cebus imitator THOMAS, Ann. Mag. Nat. Hist., Ser. 7, Vol. 11, p. 376, April, 1903. Type from Boquete, Chiriqui, Panama.

The Panama white-throated capuchin inhabits the general region from the Canal Zone westward and northward to Costa Rica. No external character is known by which it may be distinguished from *C. capucinus capucinus* of eastern Panama, but the decidedly greater average transverse extent of the premolars above and below seem to entitle it to subspecific recognition. The upper premolars are usually broader than the first molar, while in typical *C. capucinus* the width of these teeth is about the same. In Central America the capuchins exhibit a progressive increase from south to north, in the width of the premolars, the maximum development noted being in specimens of *Cebus c. limitaneus* Hollister from Honduras.

An example of the Panama white-throated capuchin was obtained at Gatun, Canal Zone, which seems to be near the eastern limit of the range of the subspecies. Mr. Alston (1879, p. 13) mentions specimens in the British Museum obtained by Arcé in Veragua. Two topotypes collected by Mr. W. W. Brown, Jr., are recorded by Mr. Outram Bangs (1902, p.51) as *Cebus hypoleucus*. Under the same name five specimens of this species taken at Boqueron and one at Boquete by Mr. J. H. Batty are listed by Dr. J. A. Allen (1904, p. 80) who remarks that the males and females do not appear to differ in the relative elongation, or color, of the hair of the frontal region. In discussing six specimens of the capuchin of Coiba Island Mr. Oldfield Thomas (1902, p. 135) says: "I can find absolutely no difference, either in size or colour, between these and mainland specimens. Considering the small size of the island there is a noticeable amount of variation within the series, both with regard to the extension of the white on the arms and shoulders and in the skull in the height of the nasal bones." Skulls of specimens from Coiba Island in the American Museum of Natural History are rather small and in the narrowness of the premolars might, with nearly equal propriety, be referred to typical *C. c. capucinus*.

So little is known of the habits of the capuchins in Panama that the following observations on the same species by Belt[1] in Nicaragua seem worth quoting: "Sometimes . . . . we would fall in with a troop of the white-faced cebus monkey, rapidly running away, throwing themselves from tree to tree. This monkey feeds also partly on fruit, but is incessantly on the lookout for insects, examining the

[1] Naturalist in Nicaragua, p. 118, 1888.

crevices in trees and withered leaves, seizing the largest beetles and munching them up with great relish. It is also very fond of eggs and young birds, and must play havoc amongst the nestlings. Probably owing to its carnivorous habits, its flesh is not considered so good by monkey-eaters as that of the fruit-feeding spider-monkey. . . . I kept one for a long time as a pet, and was much amused with its antics. . . . . I had it fastened with a light chain; but it managed to open the links and escape several times, and then made straight for the fowls' nests, breaking every egg it could get hold of . . . . Its chain allowed it to swing down below the verandah, but it could not reach to the ground. Sometimes, when there were broods of young ducks about, it would hold out a piece of bread in one hand, and, when it had tempted a duckling within reach, seize it by the other, and kill it with a bite in the breast."

Specimens examined: Boqueron, 6[1]; Boquete, 2[2]; Coiba Island, 12[1]; Gatun, 1; without definite locality, 9.[1]

Family ATELIDAE. Spider Monkeys

The Atelidæ form a surpassingly arboreal group of species. The great length and power of the tail as a grasping organ and the slenderness of the limbs, in allusion to which these animals are commonly called spider monkeys, permit a rapidity of progression through tree tops that is often marvelous.

Genus ATELES E. Geoffroy

This genus is composed of rather large, but slender, long-limbed species with very long, prehensile tails, naked on the under side near the tip. In general external appearance they are not very unlike the howling monkeys of the genus *Alouatta*, but are easily recognizable by the absence of the thumbs and consequent reduction of the number of fingers on the hands to four, instead of five as in all the other primates of the region. Two species are known to inhabit Panama.

ATELES GEOFFROYI Kuhl

Geoffroy's Spider Monkey; Mono Colorado

Ateles geoffroy [*sic*] KUHL, Beiträge z. Zoologie, 1820, p. 26. Type locality unknown.

Although somewhat variable in general color the "mono colorado" is usually reddish as the native name indicates, and by this character is distinguishable from the black spider monkey of Panama. Parts

[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Mus. Comp. Zool.

of the early account of monkeys in Panama by Lionel Wafer (1729, p. 330) may have been based on observation of this species.

Geoffroy's spider monkey was not met with by me in the Canal Zone, but the species was recorded by Alston (1879, p. 8) from Colon, as living in the gardens of the Zoological Society of London. It is known to range in western Panama whence a specimen was referred by Sclater (1872, p. 4) to *Ateles melanochir*. He says: "There is also in the British Museum a skin of this Spider Monkey procured by Salvin's collector Arcé near Calovevora, in Veragua." Since the species is not included in the more recent and extensive collections made in Chiriqui by W. W. Brown, Jr., and J. H. Batty, it may not be very common there. It appears, however, to be better known throughout much of Costa Rica.

One was killed by a native hunter at about 2,000 feet altitude on Cerro Brujo near Porto Bello. A troop of 12 or 15 was seen by me near the Cascajal River, at the base of this mountain, but quickly escaped by climbing through the tall trees up a steep slope. At about 800 feet altitude on Cerro Azul, near the headwaters of the Chagres River. I came suddenly upon a small party the exact number of which I was unable to determine. Here I was especially impressed by the remarkable climbing powers of the animal. Some of them were seen to run along large horizontal limbs mainly on their hind feet, but holding on also with both hands and tails. Arriving at the end of a branch a tremendous flying leap carried one across an intervening space to another tree. The species was free from the larvæ of flies which infest the howling monkeys and the flesh is more highly prized as food by the natives.

Specimens examined: Cerro Azul, 2; Cerro Brujo, 1.

ATELES DARIENSIS Goldman

Darien Black Spider Monkey

[Plate 38, figs. 2, 2a]

Ateles dariensis GOLDMAN, Proc. Biol. Soc. Washington, Vol. 28, p. 101, April 13, 1915. Type from near head of Rio Limon, Mount Pirre, eastern Panama (altitude 5,200 feet).

Eastern Panama is inhabited by a rather small spider monkey easily recognizable by its uniform black color from the "mono colorado" or reddish species, *Ateles geoffroyi*. The monkey appears to be a Darien representative of the *A. ater* group of South America. The type from the heavy forest near the summit of Mount Pirre was the only example taken by me. The species was not encountered in the course of my work in the Canal Zone, but Sclater (1872, p. 5) mentions several living specimens received by the Zoological Society of

London and said to have been procured at Colon. Anthony (1916, p. 375) records examples from Tapalisa and reports having once noted this species at 5,000 feet near Mount Tacarcuna in the Serrania del Darien northeast of the type locality. The exact relationship of *A. dariensis* to the little known *Ateles rufiventris* Sclater (1872, p. 688, pl. 57) is somewhat problematical. The latter species, which was described from the Rio Atrato and may range into Panama, seems, however, sufficiently distinguished by the bright rufous color of the underparts.

Specimens examined: Cituro, 1[1]; Mount Pirre (type locality), 1; Tapalisa, 1.[1]

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Contains original description of *Vampyrodes major*, p. 38, and critical notes on several other species of bats recorded from Panama.

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1902. A Preliminary Study of the South American Opossums of the Genus *Didelphis*. Bull. Amer. Mus. Nat. Hist., Vol. 16, pp. 249-279, August 18, 1902.

A revision of the group, including the Panaman subspecies, *Didelphis marsupialis battyi*, p. 264, and the Peruvian form, *Didelphis marsupialis etensis*, p. 263, of which specimens are recorded from Panama.

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[1] Specimens in Amer. Mus. Nat. Hist.

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This revisionary work treats also the Panaman forms, *Microsciurus alfari alfari*, p. 191, *M. a. venustulus*, p. 191, *M. a. browni*, p. 191, *M. boquetensis*, p. 191, also *Mesosciurus gerrardi morulus* (=*Sciurus gerrardi morulus*), p. 243, *Mesosciurus gerrardi choco* (=*Sciurus gerrardi choco*), p. 244, and *Microsciurus* [sic=*Mesosciurus*] *hoffmanni chiriquensis* (=*Sciurus hoffmanni chiriquensis*), p. 320.

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An annotated list of 12 species of which the following six are described as new: *Marmosa fulviventer,* p. 632, *Lepus* (*Tapeti*) *incitatus* (=*Sylvilagus gabbi incitatus*), p. 633, *Dasyprocta callida,* p. 635, *Loncheres labilis* (=*Diplomys labilis*), p. 638, *Proechimys burrus,* p. 640, *and Zygodontomys seorsus,* p. 642.

1902. Chiriqui Mammalia. Bull. Mus. Comp. Zool., Vol. 39, No. 2, pp. 17-51, April, 1902.

An annotated list of 63 species and subspecies collected by W. W. Brown, Jr., mainly on the Volcan de Chiriqui, including descriptions of a new genus (*Syntheosciurus*, p. 25) and 18 new forms as follows: *Tayassu crusnigrum* (=*Pecari angulatus crusnigrum*), p. 20, *Sciurus æstuans chiriquensis* (=*Sciurus hoffmanni chiriquensis*), p. 22, *Sciurus browni* (=*Microsciurus alfari browni*), p. 24, *Syntheosciurus brochus*, p. 25, *Megadontomys flavidus* (=*Peromyscus flavidus*), p. 27, *Peromyscus cacabatus* (=*Peromyscus nudipes*), p. 29, *Nyctomys nitellinus* (=*Nyctomys sumichrasti nitellinus*), p. 30, *Sigmodon austerulus*, p. 32, *Oryzomys devius*, p. 34, *Oryzomys vegetus* (=*Oryzomys fulvescens vegetus*), p. 35, *Reithrodontomys australis vulcanius* (=*Reithrodontomys australis australis*), p. 38, *Reithrodontomys creper*, p. 39, *Akodon teguina apricus* (=*Scotinomys teguina apricus*), p. 40, *Akodon xerampelinus* (=*Scotinomys xerampelinus*), p. 41, *Macrogeomys cavator*, p. 42, *Macrogeomys pansa*, p. 44, *Heteromys repens* (=*Heteromys desmarestianus repens*), p. 45, and *Agouti paca virgatus* (=*Cuniculus paca virgatus*), p. 47. This paper is one of the most important single contributions to knowledge of the mammals of Panama.

1905. See Thayer and Bangs.

1906. Vertebrata of the Savanna of Panama, II, Mammalia. Bull. Mus. Comp. Zool., Vol. 46, pp. 212-213, January, 1906.

Records *Sciurus adolphei dorsalis* (=*Sciurus variegatoides helveolus*), p. 212, *Promops nanus* (=*Eumops nanus*), p. 212, *Hemiderma castaneum* (=*Hemiderma perspicillatum aztecum* erroneously identified), p. 213, and *Artibeus intermedius* (=*Artibeus jamaicensis*), p. 213.

BROOKE, SIR VICTOR.

1878. On the Classification of the *Cervidae*, with a Synopsis of the existing Species. Proc. Zool. Soc. London, pp. 883-928, Nov. 19, 1878.

Records *Cariacus mexicanus* (=*Odocoileus chiriquensis*), p. 919, from Panama.

DAMPIER, WILLIAM.

1698-1703. Dampier's Voyages, Vols. 1-3, London, 1698-1703.

[Vol. 1, unnumbered] A New Voyage Round the World, Describing particularly the Isthmus of America . . . . The third edition corrected pp. 1-550, 1698.

Vol. 2. Voyages and Descriptions. In Three Parts, viz.

1. A Supplement of the Voyage Round the World, Describing the Countreys of Tonquin, Achin, Malacca, etc. . . . pp. 1-180.
2. Two Voyages to Campeachy . . . . pp. 1-132.
3. A discourse of Trade Winds . . . . pp. 1-112.

Vol. 3. A Voyage to New Holland, etc., in the year, 1699 . . . . pp. 162. 1703.

An edition published in 1729 includes Wafer's New Voyage and description of the Isthmus of America, as an appendix to the third volume. (See Wafer).

GILL, THEODORE.

1865. Proc. Acad. Nat. Sci. Philadelphia, 1865, p. 183.

Description of a new genus and species, *Elasmognathus bairdii* (= *Tapirella bairdii*), from the Isthmus of Panama, presented as a communication at meeting of October 10 and later published.

GOLDMAN, EDWARD A.

1911. Revision of the Spiny Pocket Mice (Genera *Heteromys* and *Liomys*). North Amer. Fauna, No. 34, pp. 1-63, pls. 1-3, September 7, 1911.

Includes *Heteromys repens* (= *Heteromys desmarestianus repens*), p. 27, and *Liomys adspersus*, p. 51, from Panama.

1912. Descriptions of Twelve New Species and Subspecies of Mammals from Panama. Smiths. Misc. Coll., Vol. 56, No. 36, pp. 1-11, February 19, 1912.

Original descriptions of *Marmosa isthmica* (= *Marmosa mexicana isthmica*), p. 1, *Metachirus nudicaudatus dentaneus*, p. 2, *Sciurus variegatoides helveolus*, p. 3, *Microsciurus alfari venustulus*, p. 4, *Oryzomys idoneus* (= *Oryzomys caliginosus idoneus*), p. 5, *Oryzomys frontalis* (= *Oryzomys tectus frontalis*), p. 6, *Oryzomys bombycinus*, p. 6, *Oryzomys gatunensis*, p. 7, *Zygodontomys cherriei ventriosus*, p. 8, *Heteromys panamensis* (= *Heteromys desmarestianus panamensis*), p. 9, *Heteromys zonalis* (= *Heteromys desmarestianus zonalis*), p. 9, and *Hoplomys goethalsi* (= *Hoplomys gymnurus goethalsi*), p. 10.

1912a. New Mammals from Eastern Panama. Smiths. Misc. Coll., Vol. 60, No. 2, pp. 1-18, September 20, 1912.

Original descriptions of *Peramys melanops*, p. 2, *Marmosa invicta*, p. 3, *Microsciurus isthmius vivatus*, p. 4, *Peromyscus pirrensis*, p. 5, *Neacomys pictus*, p. 6, *Rheomys raptor*, p. 7, *Macrogeomys dariensis*, p. 8, *Heteromys crassirostris* (= *Heteromys desmarestianus crassirostris*), p. 10, *Hydrochœrus isthmius*, p. 11, *Isothrix darlingi* (= *Diplomys darlingi*), p. 12, *Sylvilagus gabbi messorius*, p. 13, *Icticyon panamensis*, p. 14, *Bassaricyon gabbi orinomus*, p. 16, and *Cryptotis merus*, p. 17.

1913. Descriptions of New Mammals from Panama and Mexico. Smiths. Misc. Coll., Vol. 60, No. 22, pp. 1-20, February 28, 1913.

Includes original descriptions of the following Panaman forms: *Bradypus ignavus*, p. 1, *Mazama tema reperticia* (= *Mazama sartorii reperticia*), p. 2, *Sciurus variabilis choco* (= *Sciurus gerrardi choco*), p. 4, *Oryzomys pirrensis*, p. 5, *Nectomys alfari efficax*, p. 7, *Rhipidomys scandens*, p. 8, *Heteromys australis conscius*, p. 8, *Dasyprocta punctata dariensis*, p. 11, *Potos flavus isthmicus*, p. 14, *Euprocyon cancrivorus panamensis* (= *Procyon cancrivorus panamensis*), p. 15, *Alouatta palliata inconsonans*, p. 17.

1914. Descriptions of Five New Mammals from Panama. Smiths. Misc. Coll., Vol. 63, No. 5, pp. 1-7, March 14, 1914.

Original descriptions of *Chironectes panamensis,* p. 1, *Lonchophylla concava,* p. 2, *Lutra repanda,* p. 3, *Felis pirrensis,* p. 4, and *Aotus zonalis,* p. 6.

1914a. The Status of *Cebus imitator* Thomas. Proc. Biol. Soc. Washington, Vol. 27, p. 99, May 11, 1914.

Type region of *Cebus capucinus capucinus* fixed as northern Colombia; *Cebus capucinus imitator* regarded as a valid subspecies.

1915. A New Spider Monkey from Panama. Proc. Biol. Soc. Washington, Vol. 28, pp. 101-102, April 13, 1915.

Original description of *Ateles dariensis,* p. 101.

1915a. Five New Rice Rats of the Genus *Oryzomys* from Middle America. Proc. Biol. Soc. Washington, Vol. 28, pp. 127-130, June 29, 1915.

Includes original description of *Oryzomys alfaroi dariensis,* p. 128.

1917. New Mammals from North and Middle America. Proc. Biol. Soc. Washington, Vol. 30, pp. 107-116, May 23, 1917.

Includes original descriptions of *Didelphis marsupialis particeps,* p. 107, *Marmosa mexicana savannarum,* p. 108, *Pecari angulatus bangsi,* p. 109, and *Dasyprocta punctata nuchalis,* p. 113.

Gray, J. E.

1871. On a New Species of Three-toed Sloth from Costa Rica. Ann. Mag. Nat. Hist., Ser. 4, Vol. 7, p. 302, April, 1871.

Original description of *Arctopithecus griseus* (= *Bradypus griseus*), erroneously ascribed to Costa Rica; in reality from Cordillera del Chucu, western Panama.

1871a. Notes on the Species of Bradypodidæ in the British Museum. Proc. Zool. Soc. London, 1871, pp. 428-449, May 2.

Contains notes on *Arctopithecus griseus* (= *Bradypus griseus*), p. 446, from Panama.

1873. Notes on the Rats; with the Description of some new Species from Panama and the Aru Islands. Ann. Mag. Nat. Hist., Ser. 4, Vol. 12, pp. 416-419, November, 1873.

Includes original description of *Neomys panamensis* (= *Tylomys panamensis*), p. 417.

Hahn, Walter L.

1907. A Review of the Bats of the Genus Hemiderma. Proc. U. S. Nat. Mus., Vol. 32, pp. 103-118, February 8, 1907.

Records *Hemiderma perspicillatum aztecum,* p. 112, from Panama (city), Boqueron, and Colon.

Hale, H. C.

1903. Notes on Panama, pp. 1-271, with maps and illustrations, November, 1903, Washington, Govt. Printing Office.

A compilation of general information relating to Panama, including very brief references to a few mammals.

HOWELL, ARTHUR H.

1914. Revision of the American Harvest Mice. North Amer. Fauna, No. 36, pp. 1-81, pls. 1-7, June 5, 1914.

Treats *Reithrodontomys creper,* p. 79, and records *Reithrodontomys australis australis,* p. 62, and *Reithrodontomys mexicanus cherrii,* p. 73, from Panama.

HUET, M.

1883. Note sur les Carnassiers du Genre Bassaricyon. Nouv. Arch. du Mus. d'Hist. Nat. de Paris, 2° sér., V, pp. 1-12, pls. i-iii., 1883.

Describes and figures two specimens from "Caïmito, province de Correo, un peu au nord de Panama."

MAACK, G. A.

1874. Report on the Geology and Natural History of the Isthmuses of Choco, of Darien, and of Panama, pp. 155-175, in Reports of Explorations and Surveys to Ascertain the Practicability of a Ship-Canal between the Atlantic and Pacific Oceans by Thomas Oliver Selfridge, Washington, 1874.

A few mammals of the general region are mentioned, usually no definite locality being given. A very small collection of mammals was sent by Maack to the Museum of Comparative Zoology, but labels bear only indefinite locality records, usually "Isthmus of Panama."

MERRIAM, C. HART.

1901. Preliminary Revision of the Pumas (*Felis concolor* group). Proc. Washington Acad. Sci., Vol. 3, pp. 577-600, December 11, 1901.

Includes original description of *Felis bangsi costaricensis,* p. 596, from Boquete, Panama.

MILLER, JR., GERRIT, S.

1900. A New Free-tailed Bat from Central America. Ann. Mag. Nat. Hist., Ser. 7, Vol. 6, pp. 470-471, November, 1900.

Original description of *Promops nanus* (=*Eumops nanus*), from Bugaba, Chiriqui.

1911. Descriptions of Two New Raccoons. Proc. Biol. Soc. Washington, Vol. 24, pp. 3-6, January 28, 1911.

Includes original description of *Procyon pumilus* (=*Procyon lotor pumilus*), p. 3.

1912. A Small Collection of Bats from Panama. Proc. U. S. Nat. Mus., Vol. 42, No. 1882, pp. 21-26, March 6, 1912.

An annotated list of 11 species including the three following which are described as new: *Lonchophylla robusta,* p. 23; *Vampyressa minuta;* p. 25, *Chiroderma isthmicum,* p. 25.

1913. Notes on the Bats of the Genus *Molossus.* Proc. U. S. Nat. Mus., Vol. 46, pp. 85-92, August 23, 1913.

A preliminary revision of the genus in which the following species are recorded from Panama: *Molossus sinaloæ,* p. 89, from Punta de Peña (near Bocas del Toro); *Molossus bondæ,* p. 89, from Chorrera; *Molossus coibensis,* p. 92, from Ancon, Chorrera, Culebra, Paraiso, San Pablo, and Tabernilla.

1913a. Revision of the Bats of the Genus *Glossophaga.* Proc. U. S. Nat. Mus., Vol. 46, pp. 413-429, December 31, 1913.

Records *Glossophaga soricina leachii,* p. 419, from Balboa, "Canal Zone," Colon, and Paraiso.

NELSON, E. W.

1903. A New Pygmy Squirrel from Central America. Proc. Biol. Soc. Washington, Vol. 16, p. 121-122, September 30, 1903.

Original description of *Sciurus* (*Microsciurus*) *boquetensis* (=*Microsciurus boquetensis*) from Boquete, Panama.

1909. The Rabbits of North America. North Amer. Fauna, No. 29, pp. 1-287, pls. 1-13, August 31, 1909.

A revision of the group including *Sylvilagus gabbi incitatus,* p. 261, and records of *Sylvilagus gabbi gabbi,* p. 261, from Panama.

1912. Two Genera of Bats New to Middle America. Proc. Biol. Soc. Washington, Vol. 25, p. 93, May 4, 1912.

Records *Dirias minor* (=*D. albiventer minor*) from Empire, and *Macrophyllum macrophyllum* from Old Panama.

OSGOOD, WILFRED H.

1909. Revision of the Mice of the American Genus *Peromyscus.* North Amer. Fauna, No. 28, pp. 1-267, pls. 1-8, April 17, 1909.

Recognizes *Peromyscus flavidus,* p. 221, and records *Peromyscus nudipes,* p. 195, from Panama.

PETERS, W.

1874. Hr. W. Peters las über die Taschenmäuse, Nager mit äusseren taschenförmigen Backentaschen, und eine neue Art derselben, *Heteromys adspersus,* aus Panama. Monatsber. k. preuss. Akad. Wissensch. Berlin, pp. 354-359.

Original description of *Heteromys adspersus* (=*Liomys adspersus*), p. 357, with pl.

PUCHERAN, J.

1845. Description de quelques Mammiferes Americains par le M. le Docteur Pucheran. Rev. Zool., pp. 335-337, September, 1845.

Contains original description of *Hapale geoffroyi* (=*Leontocebus geoffroyi*), p. 336, from Panama. Type locality given under *Hapale illigeri* Pucheran, on same page.

REINHARDT, J.

1872. Et Bidrag til Kundskab om Aberne i Mexiko og Central-amerika. Vidensk. Middel. Nat. For. Kjöbenhavn, pp. 150-158, 1872.

Description of a new species, *Chrysothrix örstedii* (=*Saimiri örstedii*), p. 157, from Chiriqui.

SCLATER, PHILIP LUTLEY.

1856. List of Mammals and Birds Collected by Mr. Bridges in the Vicinity of David in the Province of Chiriqui in the State of Panama. Proc. Zool. Soc., 1856, pp. 138-143.

Records the following species: *Saimiris sciurea* (Linn.) = (*Saimiri örstedii*), p. 139, *Sciurus ———?* (=*Sciurus variegatoides melania*), p. 139, *Sciurus æstuans* (=*Sciurus hoffmanni chiriquensis*), p. 139, *Cyclothurus didactylus* (=*Cyclopes didactylus dorsalis*), p. 139, *Cholœpus didactylus* (=*Cholœpus hoffmanni*), p. 139.

1872. On the Quadrumana found in America north of Panama. Proc. Zool. Soc. London, 1872, pp. 2-8.

Records the following species: *Saimiris entomophaga* (=*Saimiri örstedii*), p. 3, *Ateles melanochir* (=Ateles *geoffroyi*), p. 4, *Ateles ater* (=*Ateles dariensis*), p. 5, and *Midas geoffroii* (=*Leontocebus geoffroyi*, p. 8).

1875. On Several Rare or Little-known Mammals now or lately Living in the Society's Collection. Proc. Zool. Soc. London, pp. 417-423, 1875.

Records *Procyon cancrivorus* (=*Procyon cancrivorus panamensis*), p. 421, from Colon.

Shiras, George, 3rd.

1915. Nature's Transformation at Panama. Nat. Geog. Mag., Vol. 28, pp. 159-194, and 33 photographs, August, 1915.

An account of changes in faunal and physical conditions in the Gatun Lake region due to construction of Gatun Dam, including habitat notes and photographs of some of the mammals.

Thayer, John E., and Bangs, Outram.

1905. The Mammals and Birds of the Pearl Islands, Bay of Panama. Bull. Mus. Comp. Zool., Vol. 46, No. 8, pp. 137-160.

Literature cited, and a nominal list of 12 species of mammals, pp. 139-140, of which six are regarded as peculiar by Outram Bangs.

Thomas, Oldfield.

1899. Descriptions of New Neotropical Mammals. Ann. Mag. Nat. Hist., Ser. 7, Vol. 4, pp. 278-288, October, 1899.

Contains original descriptions of *Tylomys watsoni*, p. 278, and *Philander laniger pallidus*, p. 286, both from Bugaba, Chiriqui.

1900. The Geographical Races of the Tayra (*Galictis barbara*), with Notes on Abnormally Coloured Individuals. Ann. Mag. Nat. Hist., Ser. 7, Vol. 5, pp. 145-148, January, 1900.

Original description of *Galictis barbara biologiæ* (=*Tayra barbara biologiæ*), p. 146, from Calovevora, Panama.

1900a. Descriptions of New Neotropical Mammals. Ann. Mag. Nat. Hist., Ser. 7, Vol. 5, pp. 217-222, February, 1900.

The following subspecies are described as new: *Proechimys centralis panamensis* (=*Proechimys semispinosus panamensis*), p. 220, and *Proechimys centralis chiriquinus* (=*Proechimys semispinosus panamensis*), p. 220.

1901. New Myotis, Artibeus, Sylvilagus, and Metachirus from Central and South America. Ann. Mag. Nat. Hist., Ser. 7, Vol. 7, pp. 541-545, June, 1901.

Original description of *Artibeus watsoni*, p. 542, from Bugaba, Chiriqui.

1901a. New Neotropical Mammals, with a Note on the Species of Reithrodon. Ann. Mag. Nat. Hist., Ser. 7, Vol. 8, pp. 246-255, September, 1901.

Original descriptions of *Dasypterus ega panamensis*, p. 246, *Oryzomys tectus*, p. 251, and *Oryzomys panamensis* (=*Oryzomys talamancæ*, p. 252.

1902. On Some Mammals from Coiba Island, off the West Coast of Panama. Novitates Zoologicæ, Vol. 9, pp. 135-137, April, 1902.

Cebus hypoleucus (= *Cebus capucinus capucinus*), p. 135, is recorded and the following are described as new: *Alouatta palliata coibensis*, p. 135, *Dasyprocta coibæ*, p. 136, *Dama rothschildi* (= *Odocoileus rothschildi*), p. 136, and *Didelphis marsupialis battyi*, p. 137.

1902a. Notes on the Phyllostomatous Genera Mimon and Tonatia. Ann. Mag. Nat. Hist., Ser. 7, Vol. 10, pp. 53-54, July, 1902.

Records *Tonatia amblyotis* (p. 54), from Bugaba, Chiriqui.

1902b. Diagnosis of a New Central-American Porcupine. Ann. Mag. Nat. Hist., Ser. 7, Vol. 10, p. 169, August, 1902.

Original description of *Coendou rothschildi* from Sevilla Island, off Chiriqui, Panama.

1903. New Mammals from Chiriqui. Ann. Mag. Nat. Hist., Ser. 7, Vol. 11, pp. 376-382, April, 1903.

Original descriptions of *Cebus imitator* (= *Cebus capucinus imitator*), p. 376, *Diphylla centralis*, p. 378, *Bassariscus sumichrasti notinus*, p. 379, and *Coendou lænatus*, p. 381, all from Boquete, Chiriqui, and of *Diclidurus virgo*, p. 377, the type of the latter from Escazu, Costa Rica, but Panama examples are recorded.

1903a. On a Collection of Mammals from the small Islands off the Coast of Western Panama. Novitates Zoologicæ, Vol. 10, pp. 39-42, April, 1903.

An annotated list of 23 species, including a second and fuller account of *Coendou rothschildi*, p. 41, from Sevilla Island.

1904. New Forms of *Saimiri, Saccopteryx, Balantiopteryx*, and *Thrichomys* from the Neotropical Region. Ann. Mag. Nat. Hist., Ser. 7, Vol. 13, pp. 250-255, April, 1904.

Original description of *Saimiri oerstedi citrinellus*, p. 250, from Costa Rica, referred to in text.

1905. New Neotropical Molossus, Conepatus, Nectomys, Proechimys, and Agouti, with a note on the Genus Mesomys. Ann. Mag. Nat. Hist., Ser. 7, Vol. 15, pp. 584-586, June, 1905.

Contains original description of *Conepatus tropicalis trichurus*, p. 585, from Boquete, Chiriqui.

1912. New *Centronycteris* and *Ctenomys* from S. America. Ann. Mag. Nat. Hist., Ser. 8, Vol. 10, p. 638, December, 1912.

Includes original description of *Centronycteris centralis* from Bugaba, Chiriqui.

1913. The Geographical Races of the Woolly Opossum (*Philander laniger*). Ann. Mag. Nat. Hist., Ser. 8, Vol. 12, pp. 358-361, October, 1913.

A list of geographic races, and original description of *Philander laniger nauticus*, p. 359, from Gobernador Island, Panama.

WAFER, LIONEL.

1729. A New Voyage and Description of the Isthmus of America, 3d ed., London, 1729. Published as pp. 263-460 of the third volume of Dampier's Voyages. The original edition was published separately under the same title in 1699.

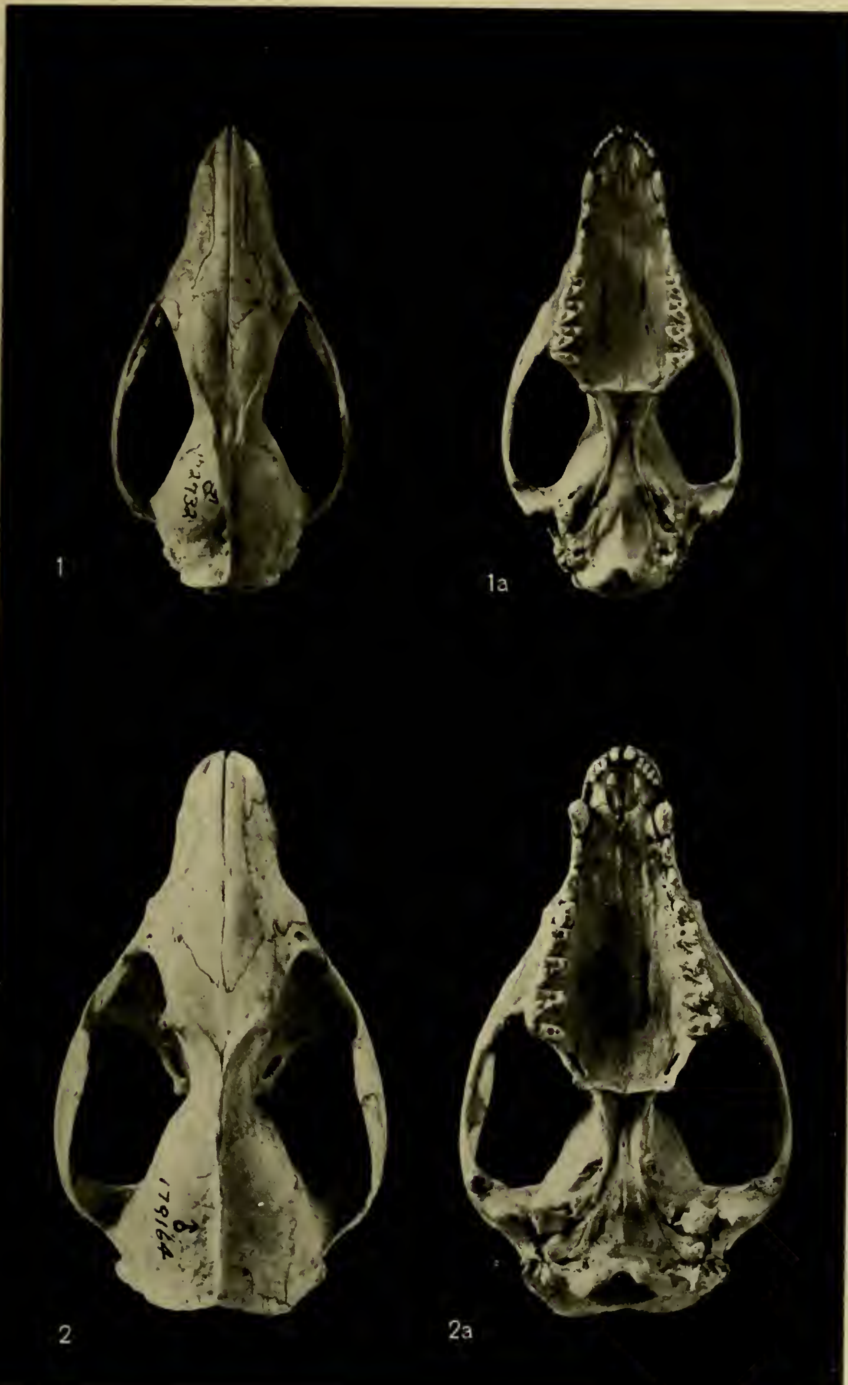
Includes quaint and interesting accounts of mammals based on observations made in eastern Panama in 1681. Owing to an accident which prevented him from marching with the others, Wafer was left behind by Dampier's party at an Indian plantation on the Rio Congo in the early part of May. He and four companions remained among the Darien Indians until the latter part of August when Dampier's party was rejoined at the "Sambaloes" (= San Blas Islands).

PLATE 20

[Natural size; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Metachirus nudicaudatus dentaneus* Goldman. Type. Gatun, Panama. January 12, 1911. ♂ (172732).

2, 2*a*. *Chironectes panamensis* Goldman. Type. Cana, Panama. March 23, 1912. ♂ (179164).


1
1a
2
2a

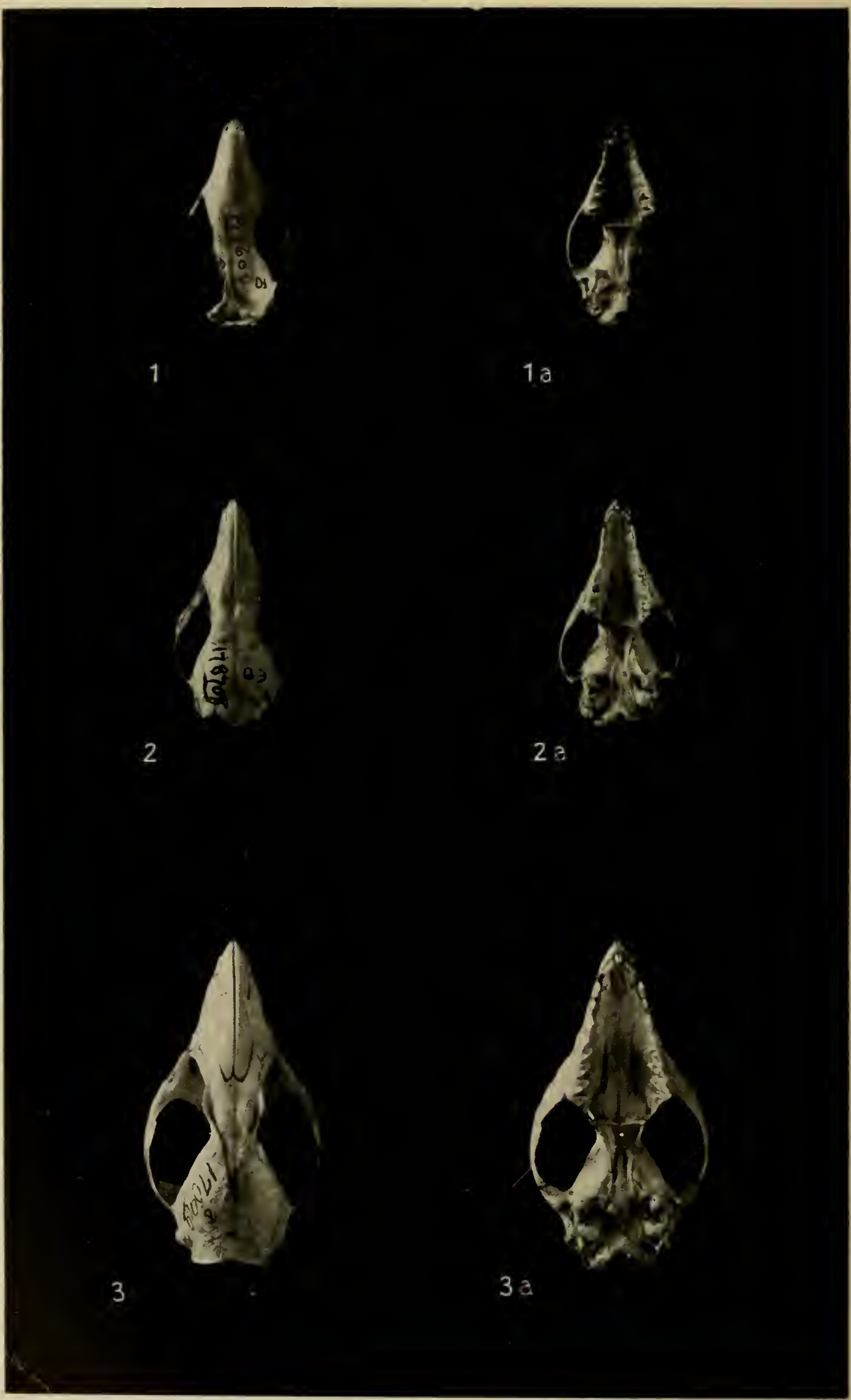

1
1a
2
2a
3
3a

PLATE 21

[Natural size; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Peramys melanops* Goldman. Type. Cana, Panama. May 23, 1912. ♂ (179609).

2, 2*a*. *Marmosa invicta* Goldman. Type. Cana, Panama. March 14, 1912. ♂ (178708).

3, 3*a*. *Marmosa mexicana isthmica* Goldman. Type. Rio Indio, near Gatun, Panama. February 16, 1911. ♂ (170969).

PLATE 22

[Natural size; in U. S. Nat. Mus., Biological Survey collection.]

Figs. 1, 1*a*. *Bradypus ignavus* Goldman. Type. Marragantí, Panama, April 6, 1912. ♀ (179551).



1



1a

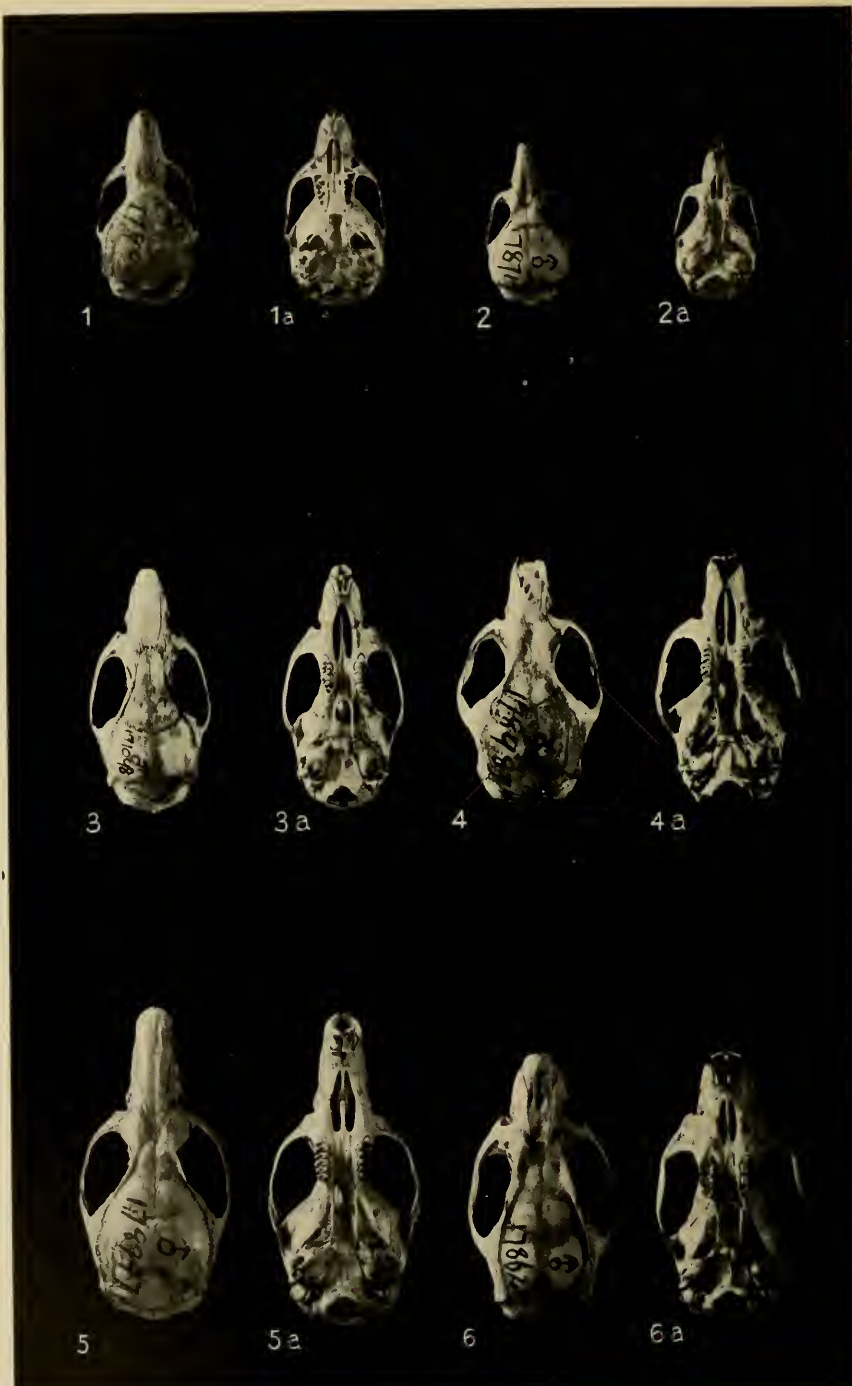

1
1a
2
2a
3
3a
4
4a
5
5a
6
6a

PLATE 23

[Natural size; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1a. *Rheomys raptor* Goldman. Type. Mount Pirre, Panama. April 28, 1912. ♂ (179028).

2, 2a. *Neacomys pictus* Goldman. Type. Cana, Panama. March 13, 1912. ♂ (178717).

3, 3a. *Zygodontomys cherriei ventriosus* Goldman. Type. Tabernilla, Canal Zone, Panama. November 12, 1911. ♂ (171098).

4, 4a. *Rhipidomys scandens* Goldman. Type. Mount Pirre, Panama. April 25, 1912. ♀ (178987).

5, 5a. *Peromyscus pirrensis* Goldman. Type. Mount Pirre, Panama. May 3, 1912. ♂ (178997).

6, 6a. *Nectomys alfari efficax* Goldman. Type. Cana, Panama. March 12, 1912. ♂ (178627).

PLATE 24

[Natural size; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Oryzomys* (*Oryzomys*) *alfaroi dariensis* Goldman. Type. Cana, Panama. March 4, 1912. ♀ (178660).

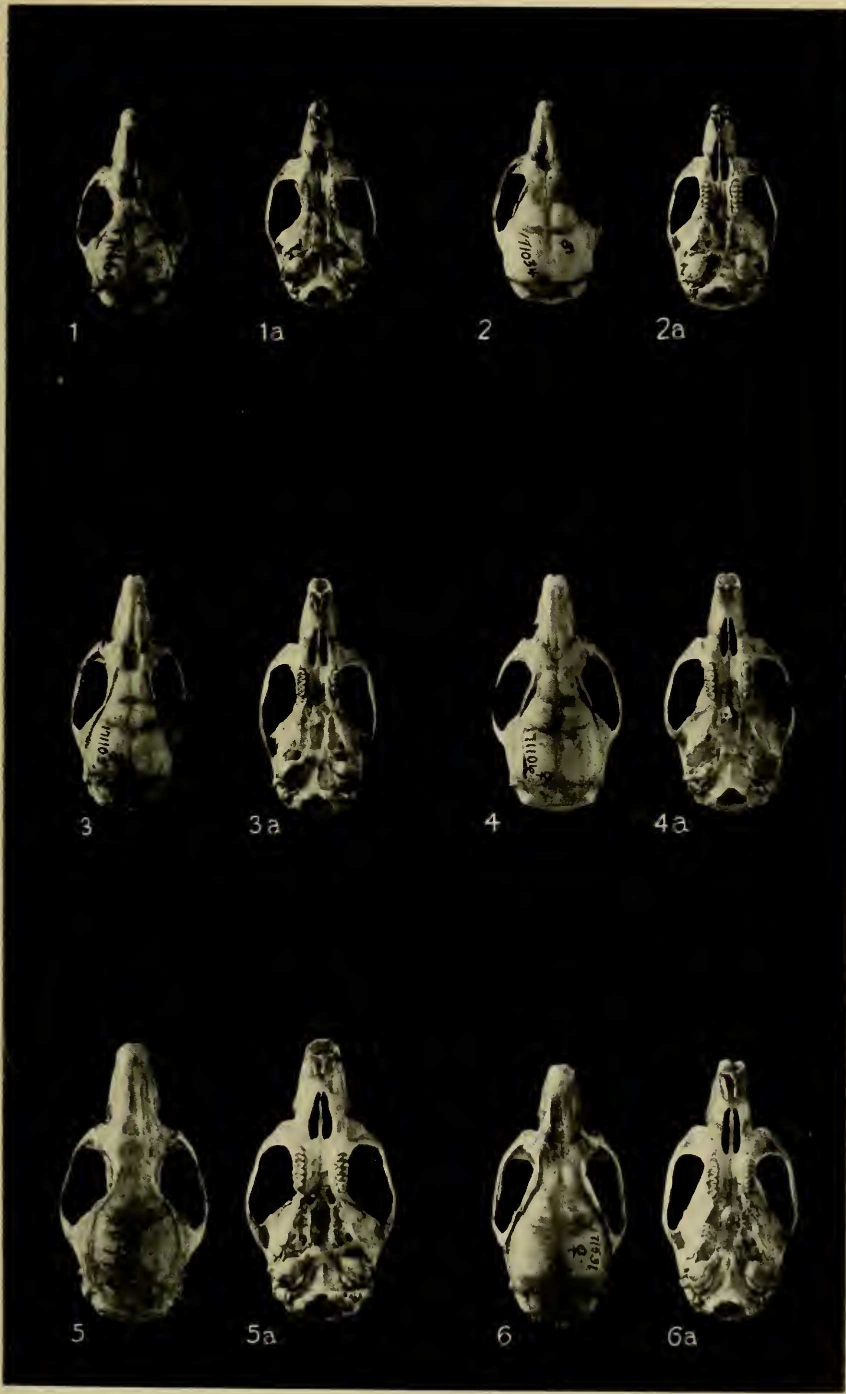
2, 2*a*. *Oryzomys* (*Oryzomys*) *gatunensis* Goldman. Type. Gatun, Canal Zone, Panama. March 7, 1911. ♂ (171034).

3, 3*a*. *Oryzomys* (*Oryzomys*) *bombycinus bombycinus* Goldman. Type. Cerro Azul, near head Chagres River, Panama. March 26, 1911. ♂ (171105).

4, 4*a*. *Oryzomys* (*Melanomys*) *caliginosus idoneus* Goldman. Type. Cerro Azul, near head Chagres River, Panama. March 26, 1911. ♀ (171106).

5, 5*a*. *Oryzomys* (*Oryzomys*) *pirrensis* Goldman. Mount Pirre, near head River Limon, Panama. April 29, 1912. ♂ adult (178993).

6, 6*a*. *Oryzomys* (*Oryzomys*) *tectus frontalis* Goldman. Type. Corozal, Canal Zone, Panama. June 20, 1911. ♂ adult (171531).


1
1a
2
2a
3
3a
4
4a
5
5a
6
6a

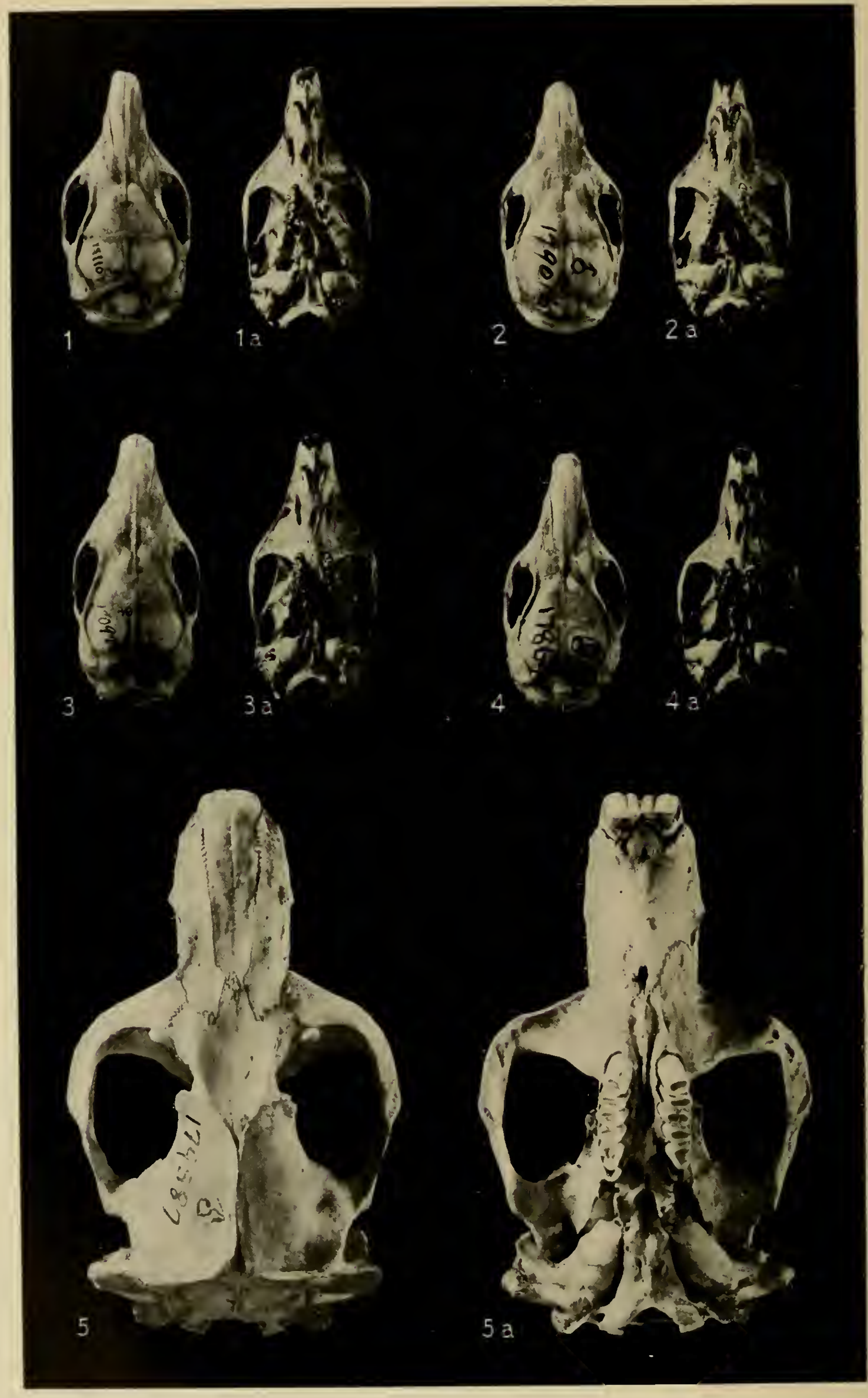

1
1a
2
2a
3
3a
4
4a
5
5a

PLATE 25

[Natural size; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Heteromys desmarestianus panamensis* Goldman. Type. Cerro Azul, near head Chagres River, Panama. March 23, 1911. ♂ adult (171107).

2, 2*a*. *Heteromys desmarestianus crassirostris* Goldman. Type. Mount Pirre, near head River Limon, Panama. April 26, 1912. ♂ adult (179016).

3, 3*a*. *Heteromys desmarestianus zonalis* Goldman. Type. Rio Indio, near Gatun, Canal Zone, Panama. February 15, 1911. ♀ adult (170976).

4, 4*a*. *Heteromys australis conscius* Goldman. Type. Cana, Panama. March 8, 1912. ♂ adult (178699).

5, 5*a*. *Macrogeomys dariensis* Goldman. Type. Cana, Panama. May 31, 1912. ♂ adult (179587).

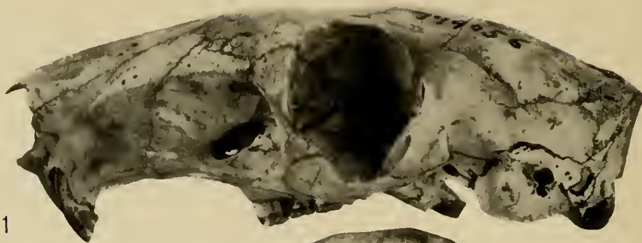
PLATE 26

[Natural size; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Diplomys darlingi* (Goldman). Type. Marragantí, Panama. May 11, 1912. Young ♀ (179577).

2, 2*a*. *Hoplomys gymnurus goethalsi* Goldman. Type. Rio Indio (near Gatun), Canal Zone, Panama. February 16, 1911. Young ♀ (170972).


1
1a
2
2a



1



1a



1b



2



2a

PLATE 27

[Natural size, except figs. 1, 1*a* and 1*b*; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*, 1*b*. *Dasyprocta punctata dariensis* Goldman. Type. Mount Pirre, near head Rio Limon, Panama. April 24, 1912. ♀ adult (179056) (three-fourths natural size).

2, 2*a*. *Sylvilagus gabbi messorius* Goldman. Type. Cana, Panama. May 23, 1912. ♂ adult (179569) (natural size).

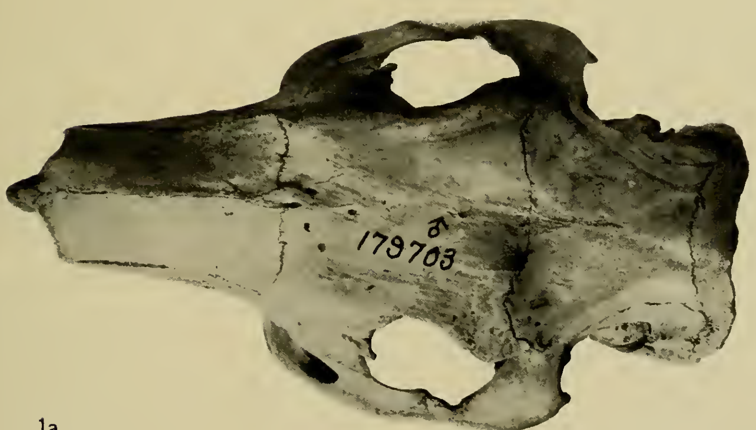
PLATE 28

[About one-half natural size; in U. S. Nat. Mus., Biological Survey collection.]

Figs. 1, 1*a*. *Hydrochoerus isthmius* Goldman. Type. Marragantí, Panama. April 4, 1912. ♂ adult (179703).



1



1a


1
1a
2
2a

PLATE 29

[Natural size; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Sciurus gerrardi choco* Goldman. Type. Cana, Panama. May 28, 1912. ♂ adult (179561).

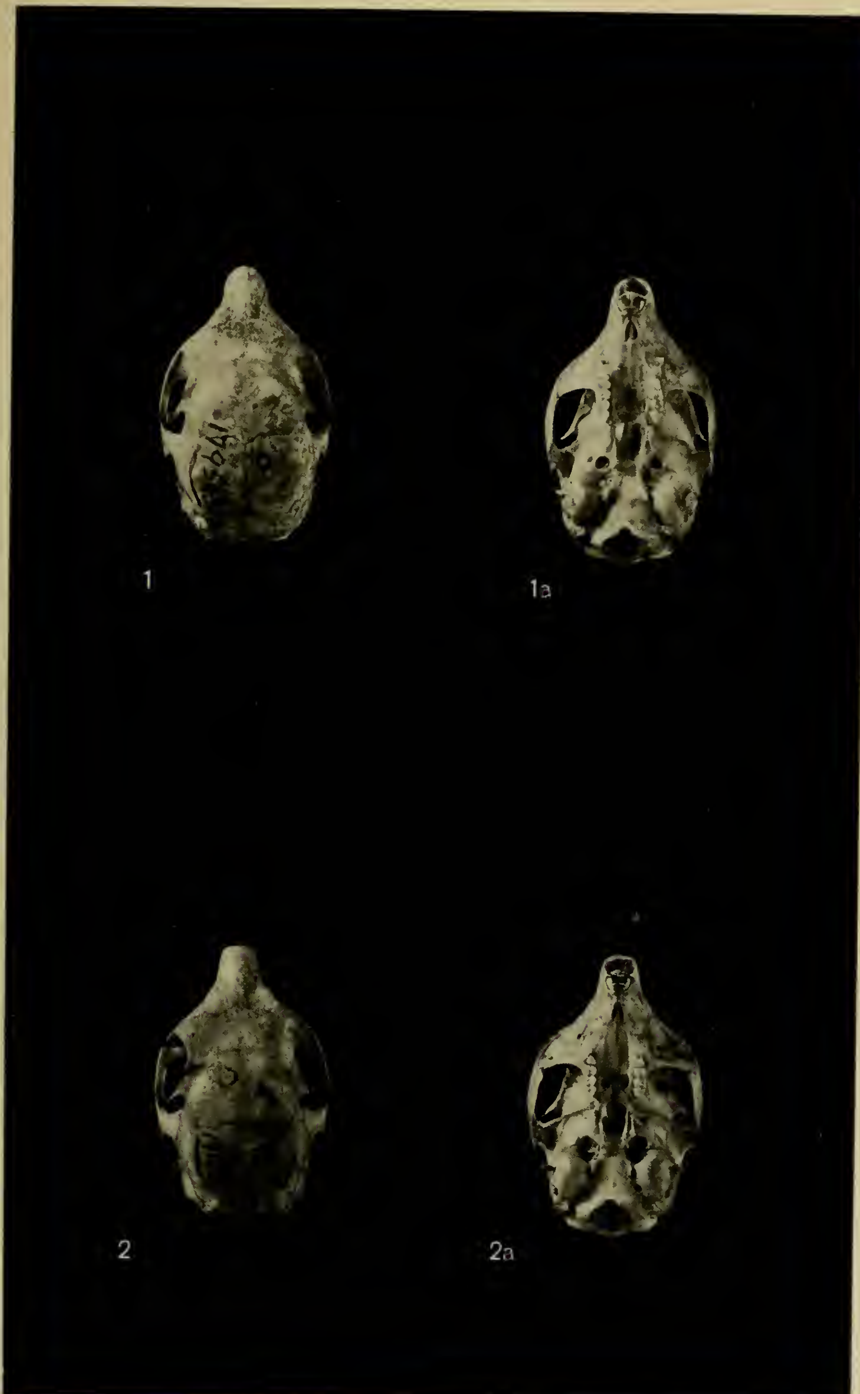
2, 2*a*. *Sciurus variegatoides helveolus* Goldman. Type. Corozal, Canal Zone, Panama. June 15, 1911. ♂ adult (171540).

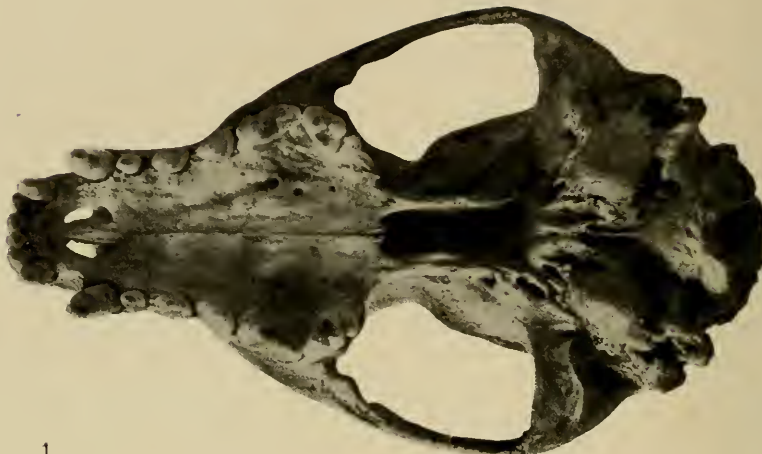
PLATE 30

[Natural size; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Microsciurus isthmius vivatus* Goldman. Type. Cana, Panama. June 5, 1912. ♀ adult (179565).

2, 2*a*. *Microsciurus alfari venustulus* Goldman. Type. Gatun, Canal Zone, Panama. March 1, 1911. ♀ (171030).


1
1a
2
2a



1



1a

PLATE 31

[Three-fourths natural size; in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Icticyon panamensis* Goldman. Type. Mount Pirre, near head Rio Limon, Panama. April 28, 1912. ♀ adult (179046).

PLATE 32

[Three-fourths natural size; in U. S. Nat. Mus. collection.]

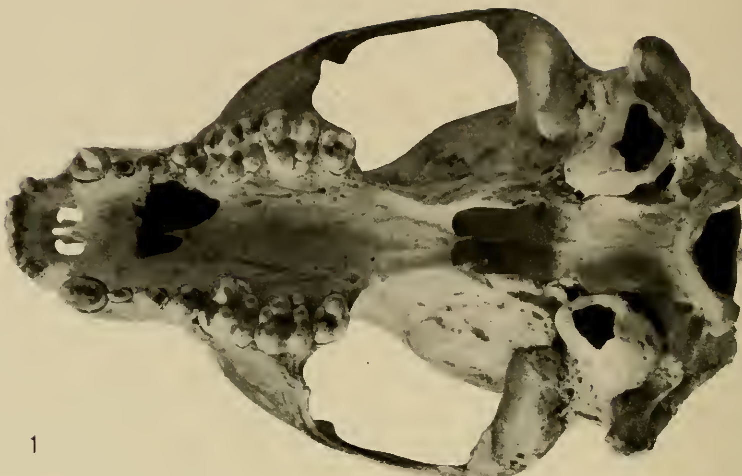
FIGS. 1, 1*a*. *Procyon lotor pumilus* Miller. Type. Ancon, Panama. (171983, U. S. Nat. Museum collection).



1



1a



1



1a

PLATE 33

[Three-fourths natural size; in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1a. *Procyon* (*Euprocyon*) *cancrivorus panamensis* (Goldman). Type. Gatun, Panama. June 21, 1911. ♀ adult (171669).

PLATE 34

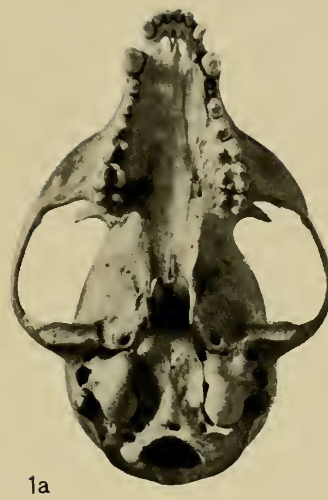
[Three-fourths natural size; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Bassaricyon gabbii orinomus* Goldman. Type. Cana, Panama. March 10, 1912. ♂ adult (179157).

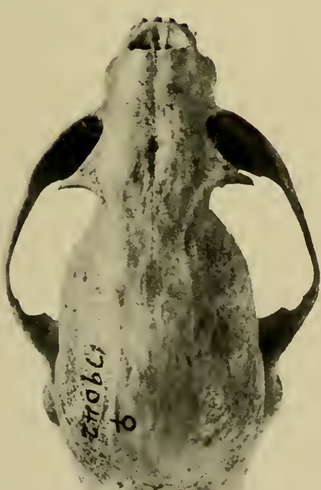
2, 2*a*. *Potos flavus isthmicus* Goldman. Type. Mount Pirre, near head Rio Limon, Panama. April 21, 1912. ♀ adult (179042).



1



1a



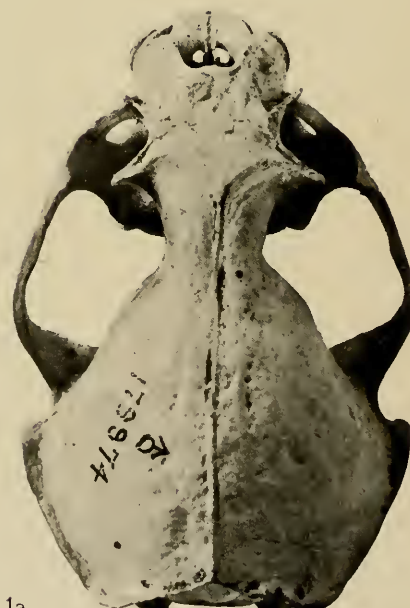
2



2a



1



1a

PLATE 35

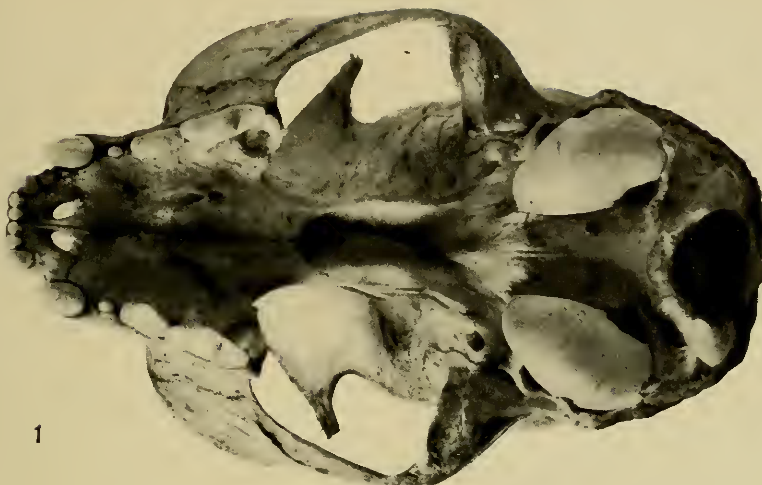
[Three-fourths natural size; in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Lutra repanda* Goldman. Type. Cana, Panama. May 30, 1912. ♂ adult (179974).

PLATE 36

[Natural size; in U. S. Nat. Mus., Biological Survey collection.]

Figs. 1, 1*a*. *Felis pirrensis* Goldman. Type. Cana, Panama. March 22, 1912. ♀ adult (179162).



1



1a


1
1a
2
2a
3
3a
4
4a
5
5a

PLATE 37

[Natural size; in U. S. Nat. Mus., Biological Survey collection, except figs. 2, 2*a*; 3, 3*a*; 4, 4*a*.]

FIGS. 1, 1*a*. *Cryptotis merus* Goldman. Type. Mount Pirre, near head Rio Limon, Panama. May 2, 1912. ♀ adult (178976).

2, 2*a*. *Chiroderma isthmicum* Miller. Type. Cabima, Panama. May, 1911. ♀ adult (173834, U. S. Nat. Mus. collection).

3, 3*a*. *Vampyressa minuta* Miller. Type. Cabima, Panama, May, 1911. ♀ imm. (173832, U. S. Nat. Mus. collection).

4, 4*a*. *Lonchophylla robusta* Miller. Type. Chilibrillo River, Panama. April 14, 1911. ♂ adult (173854, U. S. Nat. Mus. collection).

5, 5*a*. *Lonchophylla concava* Goldman. Type. Cana, Panama. May 20, 1912. ♂ adult (179621).

PLATE 38

[Natural size; except figs. 2, 2a; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1a. *Aotus zonalis* Goldman. Type. Gatun, Canal Zone, Panama. April 29, 1911. ♀ adult (171231).

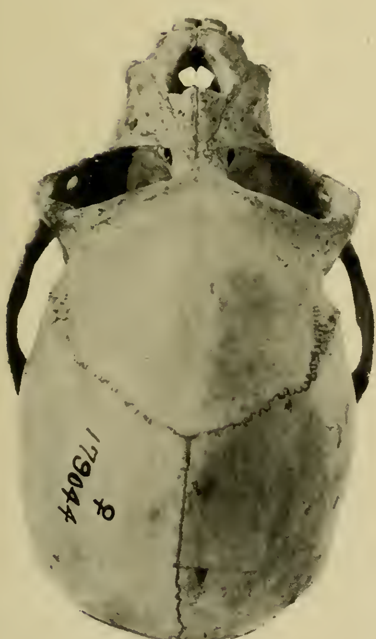
2, 2a. *Ateles dariensis* Goldman. Type. Mount Pirre, Panama. April 29, 1912. ♀ adult (179044). (Three-fourths natural size.)



1



1a



2



2a



1



1a

PLATE 39

[Three-fourths natural size; in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Alouatta palliata inconsonans* Goldman. Type. Cerro Azul, near head Chagres River, Panama. March 23, 1911. ♂ adult (171068).

INDEX

[Synonyms in *italics;* pages containing the principal reference to a species in **bold-face** figures.]

A